

## Larvae of Australian Buprestidae (Coleoptera). Part 5. Genera *Astraeus* and *Xyroscelis*, with notes on larval characters of Australian polycestine taxa

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**Abstract.** Larvae of four Australian species of the buprestid subfamily Polycestinae are described and illustrated: *Astraeus (Depollus) aberrans* van de Poll, 1886, *A. (Astraeus) prothoracicus* van de Poll, 1889 (Astraeini), *Xyroscelis crocata* Gory & Laporte, 1839, and *Xyroscelis* sp. (probably *X. bumana* Williams & Watkins, 1986) (Xyroscelidini). Described larvae are compared with other Australian polycestine genera with known larvae. Discussion on the taxonomic value and implication of larval characters of all studied Australian polycestine genera is given.

**Key words.** Coleoptera, Buprestidae, Polycestinae, Astraeini, Xyroscelidini, taxonomy, larval morphology, Australia

### Introduction

This paper follows the previous studies on Australian buprestid larvae (BÍLÝ & VOLKOVITSH 2003, 2005; VOLKOVITSH et al. 2004; BÍLÝ et al. 2013) and it is a part of the long-term project dealing with the larval taxonomy and morphology of the family Buprestidae.

The Australasian fauna comprises the following polycestine taxa (BELLAMY 2002, 2003, 2008): *Prospheres* Saunders, 1868, *Blepharum* Thomson, 1878 [not in Australia] (Prospherini); *Astraeus* Laporte & Gory, 1837 with subgenera *Astraeus* Laporte & Gory, 1837 and *Depollus* Barker, 1975 (Astraeini); *Xyroscelis* Saunders, 1868 (Xyroscelidini); *Strigoptera* Dejean, 1833, *Polycesta* Dejean, 1833 (Polycestini); *Paratrachys* Saunders, 1873 with subgenera *Paratrachys* Saunders, 1873 and *Friendiella* Holyński, 1992 (Paratrachyini); and *Helperella* Cobos, 1957 (Haplostethini). Prospherini, Astraeini, and Xyroscelidini are endemic to the Australasian Region while other tribes have worldwide (Polycestini, Haplostethini) or mainly Oriental (Paratrachyini) distributions. Of these taxa, only larvae of Prospherini

have been described so far (LEVEY 1978, VOLKOVITSH & HAWKESWOOD 1999, BÍLÝ 2000) and a larval habitus of *Astraeus (Astraeus) crassus* van de Poll, 1889 was illustrated by TURNER & HAWKESWOOD (1996).

In this paper, larvae of *Astraeus (Depollus) aberrans* van de Poll, 1886, *A. (A.) prothoracicus* van de Poll, 1889, *Xyroscelis crocata* Gory & Laporte, 1839, and *Xyroscelis* sp. (probably *X. bumana* Williams & Watkins, 1986) are described in detail, illustrated and compared with other known Australasian polycestine larvae.

## Material and methods

The morphological terminology follows that used in the papers of VOLKOVITSH (1979), VOLKOVITSH & BÍLÝ (1997, 2001), BÍLÝ (1999), VOLKOVITSH & HAWKESWOOD (1990, 1999), and BÍLÝ & VOLKOVITSH (2002, 2003).

Larvae fixed in 75% alcohol were studied. One or two larvae of each species were dissected to study the mouthparts, spiracles and proventriculus; mouthparts were separated from epicranium and from each other and mounted in the Faure-Berlese or Swan media on microscopic slides; proventriculus was extracted and dissected to study the inner structures; epicranium (without mouthparts), larval body and proventriculus were boiled in 15% KOH solution to remove soft tissues and also mounted in the abovementioned media on slides. Images of larval structures were taken using Olympus SZ-CTV dissecting microscope with mounted Olympus-Camedia 3030 Zoom camera and optic microscope Leica DME with mounted camera Panasonic Super Dynamic WV-GP460 (ZIN).

Examined material include all specimens we used for comparative purposes. Since the larvae of Australian species of *Polycesta* Dejean, 1833 (Polycestini) and *Paratrachys* Saunders, 1873 (Paratrachyini), and of all species of *Helperella* Cobos, 1957 (Haplostethini) are still unknown, we used the larvae of non-Australian representatives of these genera or tribes for diagnostic purposes.

Examined specimens are deposited in the following collections:

ANIC	Australian National Insect Collection, Canberra, Australia;
NMPC	National Museum, Prague, Czech Republic;
USNM	National Museum of Natural History, Washington, D.C., USA;
ZIN	Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia.

## Larval descriptions

### Tribe Astraeni

#### *Astraeus (Depollus) aberrans* van de Poll, 1886

(Figs 1–9, 20, 28–29, 44, 53, 61, 70, 77, 85, 114–115)

**Material examined.** AUSTRALIA: WESTERN AUSTRALIA: Peak Chartes N.P., 8.xi.2001, S. Bílý leg., *Eucalyptus* sp. (Myrtaceae), at the base of burned tree, 3 mature specimens (2 in NMPC, 1 in ZIN).

**Description.** Measurements (1 larva): body length 30.9 mm; width of prothorax 6.2 mm.

*Larva* of buprestoid type (Figs 1, 20), morpho-ecological subtype 2 (VOLKOVITSH 1979, BÍLÝ 1999), prothorax poorly expanded, slightly wider than meso- and metathorax; body

creamy-white, sides of thorax with sparse, short whitish setae, sides of abdomen with inconspicuous setae.

*Head.* Epistome (Fig. 3) strongly transverse, 5.9 times as wide as long; anterior margin deeply emarginate between oval mandibular condyles, with distinct rounded projections laterally; posterior margin bisinuous, distinctly emarginate laterally; latero-posterior corners nearly rectangular, projecting outwards; lateral margins of epistome slightly emarginate; antennal incisions broad, well-defined; 4 epistomal sensilla arranged in two superficial groups of two sensilla situated nearly linearly at midlength, each group consists of one short seta and one campaniform sensillum just above seta; distance between sensilla in each group much less than that between the groups. Clypeus (Figs 3, 61) strongly transverse, 3.2 times as wide as long, membranous, glabrous.

*Labrum* (Figs 3, 61) slightly transverse, 1.2 times as wide as long, anterior margin feebly bisinuous, middle part nearly straight, lateral lobes not developed; lateral sides of labrum widely arcuate, slightly emarginate at base, subparallel; palatine sclerites with well-defined separated branches; medial branches transverse, moderately sclerotised; lateral branches well-sclerotised, strongly expanded at bases; medial sensilla of labrum (t = trichoid, c = campaniform): 1c-2t-3c, distance 1c-3c more than 1c-2t; 2t relatively short, not reaching anterior margin; antero-lateral sensilla of labrum, external group: (1t, 2c)-3t+4t; 1t and 3t relatively short but much longer than 4t, internal group: 1c-(2t, 3t,4t); labrum dorsally glabrous, ventrally (epipharynx) with large oblique areas of microspinulae along branches of palatine sclerite.

*Antennae* (Fig. 7) two-segmented, situated in very deep incision between epistome and pleurostome, basal antennomere 1.2 times as long as terminal antennomere; articular membrane glabrous; basal antennomere nearly as long as wide, barrel-shaped, with glabrous anterior margin; terminal antennomere slightly elongate, 1.3 times as long as wide at base, feebly expanded anteriorly, anterior margin with sparse microspinulae; apical cavity of terminal antennomere very shallow, bearing long trichosensilla, nearly 1.5 times as long as antennomere itself, arising from small separate cavity on external wall; sensory appendage elongate, conical, extending beyond anterior margin of cavity; two very short palmate sensilla with jointed bases and two basiconic sensilla of different length.

*Mandibles* (Figs 4, 53) triangular, 1.2 times as long as wide, strongly sclerotised at apical half, black, basal half lighter, brown; outer margin with one short seta above condyle; cutting edge with five teeth: apical tooth rather sharp, two internal teeth dorsally and ventrally both arising from common base.

*Hypostome.* Internal margin of mandibular fossae forms a big tooth-like projection, nearly reaching latero-basal sclerite of cardo (Fig. 44).

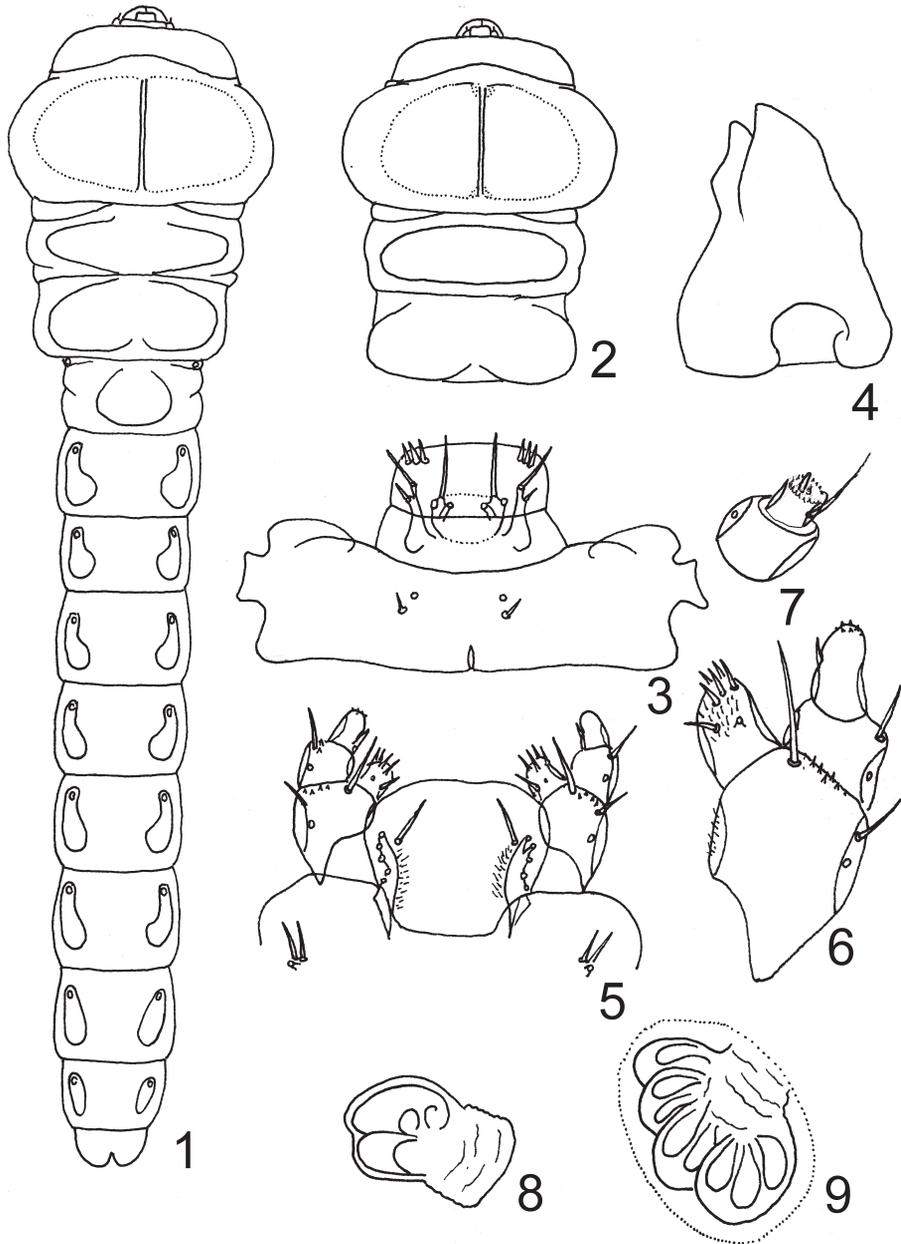
*Maxillae* (Figs 5, 6, 77, 85). Cardo subquadrate, nearly as wide as long, membranous, glabrous; latero-basal sclerite of cardo (Fig. 77) well-defined and sclerotised, bearing two short setae and one campaniform sensillum with enlarged bases. Stipes (Figs 6, 85) subquadrate, slightly wider than long; inner sclerite of stipes well-defined, with internal process very short; apical seta of stipes slightly longer than basal palpomere, situated at anterior 1/3 of stipes length between the bases of palpus and mala; lateral seta very short, situated at apex of external part of inner sclerite; external armament composed of small area of sparse, short microspinulae at antero-external corners, anterior margin glabrous, internal armament composed of sparse,

short microspinulae laterally, extending mala; additional internal lobe absent. Palpus maxillaris (Figs 6, 85): basal palpomere nearly as long as terminal palpomere; basal palpomere trapezoid, slightly transverse, 1.1 times wider than long, completely glabrous, apical seta nearly twice shorter than terminal palpomere; terminal palpomere subcylindrical, weakly narrowed and curved outward apically, 1.4 times as long as wide, with approximately ten short, peg-like apical sensilla, one of them larger than others. Mala (Figs 6, 85) slightly elongate, feebly narrowed apically, 1.2 times as long as wide; inner sclerite of mala well-defined and sclerotised, subparallel, slightly longer than wide; external armament of mala composed of one campaniform sensillum, 1 short, peg-like seta, five long robust setae, and short microspinulae apically; mala internally with 3 robust, short setae and dense microspinulae along inner side.

*Labium* (Figs 5, 70). Prementum transverse, 1.6 times as wide as long, rounded; anterior margin widely arcuate, deeply emarginate at middle, with broadly rounded corners; lateral sides widely arcuate, strongly converging posteriorly; prementum completely glabrous both dorsally and ventrally; corner sclerites of labium with poorly defined anterior part, apical seta relatively long but not extending anterior margin of prementum; five campaniform sensilla situated below the base of apical setae, three apical (two with long bases) and two basal. Postmentum glabrous, without setae.

*Thorax* (Figs 1–2, 20, 28–29). Slightly expanded, flattened, prothorax 1.2 times wider than mesothorax which is nearly as wide as metathorax and both slightly wider than 1<sup>st</sup> abdominal segment; rudiments of legs present ventrally on all thoracic segments. Prothorax transverse, 1.8 times as wide as long; anterior membrane glabrous with sparse short setae and inconspicuous microspinulae medially; lateral sides evenly rounded, with moderately dense, short, whitish setae. Both dorsal and ventral plates poorly defined, unsclerotised, colorless, limited by oblique folds. Pronotal plate (Figs 1, 28) glabrous, bearing sparse short setae and grainy superficial cuticular sculpture along the groove. Pronotal groove uniramous, widest at apex, gradually narrowed toward base where it is forked; lateral branches short, curved outwards. Prosternal plate (Figs 2, 29) glabrous, bearing sparse short setae, grainy superficial cuticular sculpture along the groove, and a few concentric rugae. Prosternal groove uniramous, inverted T-shaped, widest at apex, becoming narrower toward base where it shortly triangularly widened forming short, nearly perpendicular branches. Mesothorax (Figs 1–2, 28–29) transverse, 2.9 times as wide as long and 1.1 times wider than metathorax, with well-defined secondary fold dividing segment into two parts; glabrous, bearing sparse short setae, with hardly visible areas of poorly developed microspinulae laterally; ambulatory pads well-defined dorsally and ventrally, ovale. Metathorax (Figs 1, 2, 28, 29) transverse, 2.2 times as wide as long and 1.4 times wider than 1<sup>st</sup> abdominal segment; lateral sides with sparse short whitish setae; both dorsal and ventral sides of metathorax with distinct, transverse plates covered with microspinulae; dorsally with two large ambulatory pads separated by median depression and bearing inconspicuous cuticular sculpture laterally, ventrally with single, large, transverse, reniform medial pad.

*Abdomen* (Figs 1, 20) flattened, segments 1–8 weakly transverse, slightly wider than long; all segments laterally, segments 4–10 dorsally and 6–10 ventrally with microspinulate areas; lateral sides with sparse short whitish setae and poorly defined microspinulae; 1<sup>st</sup> abdominal segment trapezoid, narrowed posteriorly, 1.4 times as wide as long and narrower than 2<sup>nd</sup>



Figs 1–9. Larva of *Astraeus (Depollus) aberrans* van de Poll, 1886. 1 – body, dorsal view; 2 – thorax, ventral view; 3 – epistome, anteclypeus and labrum, dorsal view; 4 – right mandible, dorsal view; 5 – labio-maxillary complex, ventral view; 6 – right maxilla, ventral view; 7 – right antenna; 8 – abdominal spiracle I; 9 – mesothoracic spiracle. Drawings S. Bílý.

segment; dorsally with large ambulatory pad divided by shallow longitudinal depression, bearing rugulose sculpture; ventrally with large, medial ambulatory pad divided by transverse furrow into two parts, ends of furrow with inconspicuous inner sculpture; mainly glabrous, with sparse short setae; sides covered with microspinulae. Abdominal segments 2–8 slightly transverse, 1.3–1.6 times as wide as long; 9<sup>th</sup> abdominal segment slightly transverse, arcuately narrowed posteriorly, 1.4 times as wide as long; 10<sup>th</sup> abdominal segment conical, 1.4 times as wide as long, with vertical unsclerotised anal rim.

*Spiracles* (Figs 8–9, 114–115). Mesothoracic spiracles (Figs 9, 114) of buprestoid, cribriform type, reniform, narrow, strongly transverse, 3.3 times as wide as long, situated on sides of anterior part of mesothorax, with cancellate peritreme and numerous, branched trabeculae; spiracles surrounded with poorly defined microspinulae. Abdominal spiracles (Figs 8, 115) of the same type, reniform, narrow, transverse (that on 1<sup>st</sup> abdominal segment 2.7 times as wide as long), situated dorsally in depressions on abdominal segments 1–8, with cancellate peritreme and numerous branched trabeculae; adjacent cuticle glabrous or spiracles surrounded with poorly defined microspinulae.

*Proventriculus* (Figs 106–107) with complicate inner armament consisting of different elements and moderately developed dorsal and ventral central stripes; nearly globular, with two long, curved gastric caeca at base which are about 1.5 times longer than proventriculus itself; main fields with very dense, robust, singular microteeth situated on tubercles (Fig. 106); their margins with smaller and sparser, reduced teeth and enlarged tubercles, anteriorly with small fine microspinulae situated in rows, posteriorly with very long microspinulae changing to microteeth. Central stripes developed on both sides; dorsally incomplete, not extending apex, at base with long and dense microspinulae (Fig. 107) changing to shorter microspinulae with expanded basal tubercles then, at the middle, to short sparse microteeth, and, anteriorly, to long slender and dense fine setae; ventrally with short posterior area limited with narrow glabrous stripes, bearing long and short microspinulae directed medially and posteriorly and surrounding the field of short inconspicuous microspinulae situated in 2–3 on common bases. Glabrous areas extensive, with long wavy rugosities.

### *Astraeus (Astraeus) prothoracicus* van de Poll, 1889

(Figs 21, 30–31, 47, 54, 62, 71, 78, 86, 93–94, 108, 116–117)

**Material examined.** AUSTRALIA: WESTERN AUSTRALIA: Eneabba, 29.45°S 115.16°E, M. Peterson leg., *Banksia menziesii* R. Br. (Proteaceae), ex cones, 2 specimens, most probably fully mature larvae (1 in NMPC, 1 in ZIN).

**Description.** *Measurements* (1 larva): body length 13.2 mm; width of prothorax 3.4 mm (larva in rather poor condition, so the measurements and ratios of external structures may be incorrect).

*Larva* of buprestoid type (Fig. 21), morpho-ecological subtype 2 (Volkovitsh 1979), prothorax poorly expanded, slightly wider than meso- and metathorax; body creamy-white; body sides with very sparse, short inconspicuous setae.

*Head.* Epistome strongly transverse, 4.7 times as wide as long; anterior margin deeply emarginate between ovale mandibular condyles, with short angular projections laterally; posterior margin slightly bisinuous; latero-posterior corners obtuse, rounded, projecting outwards; lateral margins of epistome emarginate; antennal incisions well-defined, deep; four

epistomal sensilla arranged in two groups of two sensilla as in previous species. Clypeus (Fig. 62) strongly transverse, 3.1 times as wide as long, membranous, glabrous.

*Labrum* (Fig. 62) slightly transverse, 1.2 times as wide as long, nearly rectangular, lateral lobes not developed, anterior margin widely arcuate, lateral sides of labrum subparallel; palatine sclerites with well-defined and sclerotised, poorly separated branches; medial branches transverse; lateral branches strongly expanded at bases; medial sensilla of labrum ( $t$  = trichoid,  $c$  = campaniform):  $1c$ - $2t$ - $3c$ , distance  $1c$ - $3c$  nearly equal to  $1c$ - $2t$ ,  $2t$  long, extending anterior margin; antero-lateral sensilla of labrum, external group: ( $1t$ ,  $2c$ )- $3t$ - $4t$ ,  $1t$  and  $4t$  relatively short,  $3t$  longest; internal group: ( $1c$ ,  $2t$ ,  $3t$ ,  $4t$ ); labrum dorsally glabrous, ventrally (epipharynx) with large concentric areas of microspinulae, surrounding the pharynx.

*Antennae* (Fig. 47): nearly as in previous species but basal antennomere 1.6 times as long as terminal antennomere; basal antennomere elongate, 1.4 times as long as wide, subcylindrical, with glabrous anterior margin bearing a few short microspinulae; terminal antennomere elongate, 1.5 times as long as wide at base, expanded anteriorly, anterior margin with dense microspinulae; apical cavity of terminal antennomere shallow, bearing long trichosensilla, nearly 1.5 times as long as antennomere itself; sensory appendage elongate, narrow, scarcely extending beyond anterior margin of cavity; two short palmate sensilla, basiconic sensilla invisible.

*Mandibles* (Fig. 54) triangular, 1.2 times as long as wide, strongly sclerotised at apical half, black, basal half lighter, yellowish-brown; outer margin with one short seta above condyle; cutting edge with five teeth: apical tooth obtuse, two obtuse internal teeth (posterior poorly developed) dorsally and ventrally, both arising from the common base.

*Hypostome* poorly sclerotised, yellowish; internal margin of mandibular fossae not forming tooth-like projection, fossa regular, semilunar.

*Maxillae* (Figs 78, 86). *Cardo* subquadrate, nearly as wide as long, membranous, glabrous; latero-basal sclerite of *cardo* (Fig. 78) poorly defined, nearly missing, bearing two relatively long setae with elongate bases and one campaniform sensillum at base of outer seta. *Stipes* (Fig. 86) subquadrate, slightly wider than long; inner sclerite of *stipes* with well-defined, long internal process; apical seta of *stipes* as long as palpus, situated at anterior margin of *stipes* between the bases of palpus and mala; lateral seta short, situated at apex of lateral part of inner sclerite; external armament composed of fringe of sparse, short microspinulae anteriorly extending mala; internal armament composed of sparse, short microspinulae laterally; additional internal lobe absent. *Palpus maxillaris* (Fig. 86): basal palpomere nearly as long as apical palpomere; basal palpomere trapezoid, slightly transverse, 1.1 times wider than long; externally with a few short microspinulae at the base of apical seta, internally with short microspinulae along anterior margin; apical seta nearly as long as terminal palpomere; terminal palpomere subcylindrical, elongate, weakly narrowed apically, 1.8 times as long as wide, with approximately six short, peg-like apical sensilla of which two larger than others. *Mala* (Fig. 86) slightly elongate, feebly narrowed apically, 1.3 times as long as wide; inner sclerite of mala well-defined and sclerotised, subquadrate; external armament of mala composed of one campaniform sensillum, one short peg-like seta, five robust long setae, and short microspinulae apically; mala internally with three robust, short setae and without dense microspinulae along inner margin.

*Labium* (Fig. 71). Prementum slightly transverse, 1.4 times as wide as long; anterior margin widely arcuate, feebly emarginate at middle, with broadly rounded corners; lateral sides widely arcuate, subparallel; with small areas of microspinulae dorsally (hypopharynx), completely glabrous ventrally; corner sclerites of labium inconspicuous, with anterior part nearly transparent, apical setae relatively long but not extending anterior margin of prementum; five campaniform sensilla situated below the bases of apical setae, three apical (two with long bases) and two basal. Postmentum with single, asymmetrically situated short seta (? artefact, ? second seta missing).

*Thorax* (Figs 30–31, 93–94). Slightly expanded, flattened, prothorax 1.1 times wider than mesothorax which is as wide as metathorax and both slightly wider than 1<sup>st</sup> abdominal segment; rudiments of legs ventrally on all thoracic segments (Fig. 94). Prothorax transverse, 1.9 times as wide as long; anterior membrane glabrous with sparse short setae; lateral sides evenly rounded, with very sparse, short, whitish setae. Both dorsal and ventral plates poorly defined, unsclerotised, colorless, limited with oblique folds. Pronotal plate (Fig. 93) glabrous, bearing sparse short setae anteriorly, honeycomb, superficial cuticular sculpture along the groove, and numerous irregular rugae. Pronotal groove uniramous, well-defined and sclerotised, yellowish-brown, with subparallel sides, slightly expanded apically and basally, not forked at base. Prosternal plate similar to pronotal one. Prosternal groove uniramous, yellowish-brown, nearly subparallel, not T-shaped. Mesothorax (Figs 30–31) strongly transverse, 3.8 times as wide as long and 1.1 times wider than metathorax; glabrous, bearing isolated short setae; ambulatory pads transverse, poorly developed both dorsally and ventrally. Metathorax (Figs 30–31) transverse, 2.0 times as wide as long and 1.1 times wider than 1<sup>st</sup> abdominal segment; lateral sides with sparse short whitish setae; both dorsal and ventral sides of metathorax with poorly defined, transverse plates separated by medial depression dorsally and ventrally.

*Abdomen* (Fig. 21) flattened, segments 1–8 weakly transverse, slightly wider than long; all segments with very small areas of poorly defined microspinulae near the spiracles and inconspicuous, medial microspinulate stripes both dorsally and ventrally; lateral sides with sparse short whitish setae and poorly defined microspinulae; 1<sup>st</sup> abdominal segment transverse, 1.8 times as wide as long and nearly as wide as segments 2–8, ambulatory pad poorly marked. Abdominal segments 2–8 transverse, 1.6–2.2 times as wide as long. 9<sup>th</sup> abdominal segment strongly transverse, 2.3 times as wide as long; 10<sup>th</sup> abdominal segment transverse, 1.6 times as wide as long, with small, poorly defined microspinulate areas and with vertical unsclerotised anal rim.

*Spiracles* (Figs 116–117). Mesothoracic spiracles (Fig. 116) of buprestoid, multiloculate type, reniform, narrow, moderately transverse, 2.5 times as wide as long, situated on sides of anterior part of mesothorax, with cancellate peritreme and a few poorly developed, branched trabeculae; spiracles surrounded with poorly defined microspinulate areas. Abdominal spiracles (Fig. 117) of uni- or biloculate type, irregular ovale, slightly transverse (that on the 1<sup>st</sup> abdominal segment 1.3 times as wide as long), situated dorsally in depressions on abdominal segments 1–8, with poorly defined peritreme and a few unbranched trabeculae; adjacent cuticle with poorly defined microspinulate areas.

*Proventriculus* cordiform, internally with moderately developed dorsal and ventral central stripes. Main fields with very dense, robust, isolated microteeth situated on tubercles (Fig.

108); their margins with smaller and sparser, reduced teeth and enlarged tubercles, anteriorly with fine microspinulae arranged in rows, posteriorly with very long microspinulae changing to microteeth. Central stripes developed on both sides; dorsally with long and dense microteeth situated on elongated tubercles, similar to these on main fields but sparser and longer; ventrally with scale-like tubercles and long fine spinulae, occasionally situated in rows. Glabrous areas extensive, with long undulate rugae.

### Tribe Xyroscelidini

#### *Xyroscelis crocata* Gory & Laporte, 1839

(Figs 10–19, 22, 32–33, 48, 55, 64, 73, 79, 87, 95–96, 99, 109, 118–119)

**Material examined.** AUSTRALIA: WESTERN AUSTRALIA: Perth, xi.2001, S. Bilý leg., *Macrozamia* sp. (Zamiaceae), 15 specimens, different instars (10 in NMPC, 5 in ZIN).

**Description.** *Measurements:* body length 8.0–12.7 mm; width of prothorax 1.9–2.5 mm.

*Larva* of the buprestoid type (Figs 10, 22), morpho-ecological subtype 2 (Volkovitch 1979), prothorax poorly expanded, slightly wider than meso- and metathorax; body creamy-white, body sides with relatively long and dense whitish setae.

*Head.* Epistome (Fig. 12) strongly transverse, 4.0 times as wide as long; anterior margin shallowly emarginate between nearly globular mandibular condyles, with distinct long angular projections laterally (Fig. 45); posterior margin distinctly bisinuous; latero-posterior corners widely rounded, not projecting outwards; lateral margins of epistome slightly emarginate; antennal incisions deep, well-defined; four epistomal sensilla arranged in two superficial groups of two sensilla situated trapezoidally, each group consists of one campaniform sensillum anteriorly and one short seta posteriorly; distance between sensillum and seta in each group is about half distance between sensilla. Clypeus (Figs 12, 64) moderately transverse, 1.9 times as wide as long, membranous, glabrous.

*Labrum* (Figs 12, 16, 64) 1.1 times as wide as long, anterior margin widely arcuate, nearly straight medially, lateral lobes not developed; lateral sides of labrum feebly arcuate, slightly diverging posteriorly; palatine sclerites well-defined and sclerotised, medial and lateral branches merging apically and basally forming ring-like structure, medial branches transverse, stronger sclerotised medially; medial sensilla of labrum (t = trichoid, c = campaniform): 1c-2t-3c, situated at subequal distances, 2t relatively short, not reaching anterior margin; antero-lateral sensilla of labrum, external group: (1t, 2c)-3t-4t; 1t and 3t distinctly longer than 4t, internal group: 1c+(2t, 3t, 4t); labrum dorsally (Figs 12, 64) with narrow stripe of long microsetae along entire anterior margin, ventrally (epipharynx) (Fig. 16) with two longitudinal areas of dense microspinulae arising from tubercles.

*Antennae* (Figs 17, 48) two-segmented, situated in deep incision of epistome, basal antennomere 1.3 times as long as terminal antennomere; articular membrane glabrous; basal antennomere 1.1 times as long as wide, barrel-shaped, with well-defined inner sclerite and with fringe of dense microspinulae along anterior margin; terminal antennomere subcylindrical, elongate, 1.6 times as long as wide at base, distinctly expanded apically, anterior margin with long dense microspinulae; apical cavity of terminal antennomere very shallow, bearing long trichosensilla, nearly 1.5 times as long as antennomere itself; sensory appendage strongly

elongate, extending beyond anterior margin of cavity; two very short poorly visible palmate sensilla and one or two poorly visible basiconic sensilla.

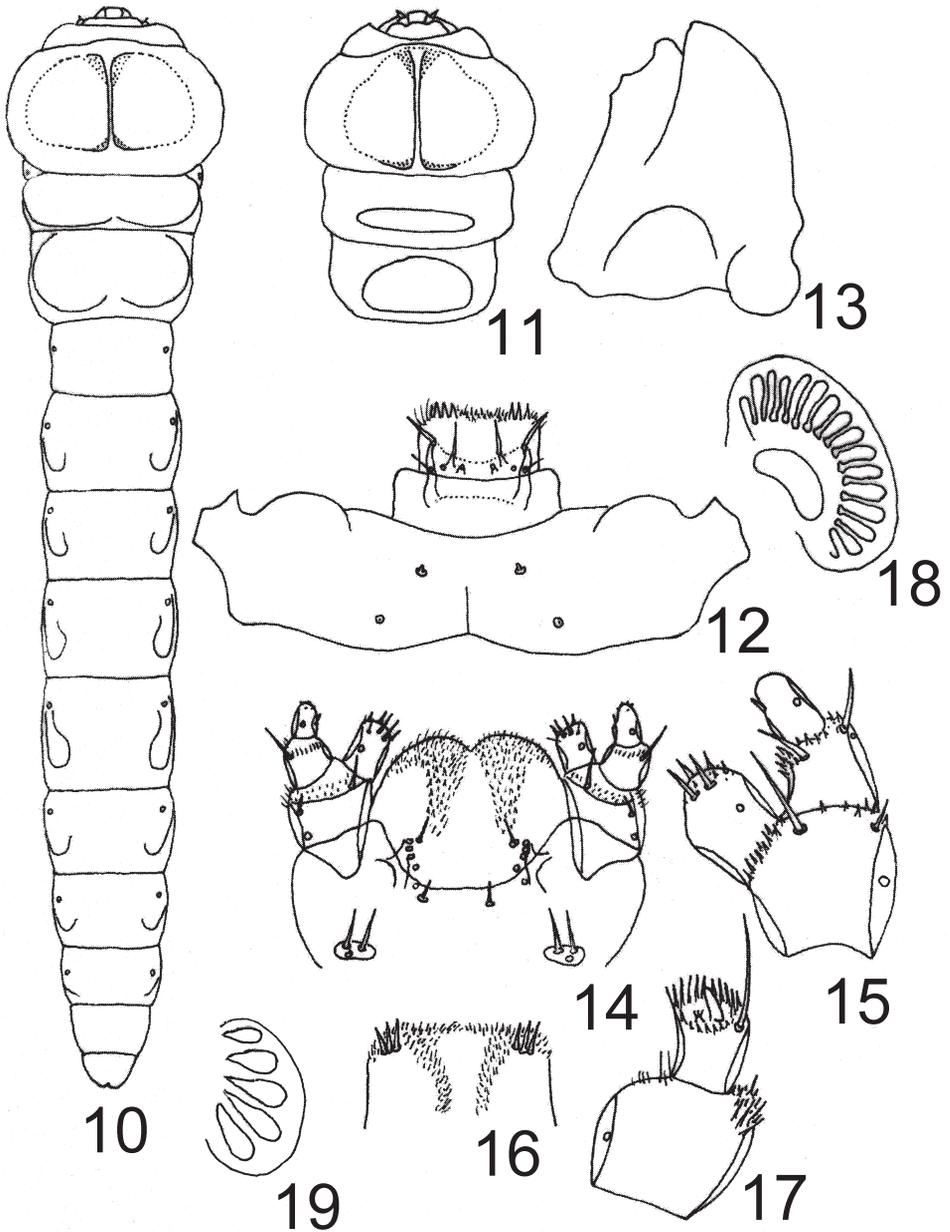
*Mandibles* (Figs 13, 55) triangular, flat, 1.3 times as long as wide, strongly sclerotised at apical half, black, basal half lighter, yellowish-brown; outer margin without seta above condyle; cutting edge with five teeth: three blunt apical teeth and two internal small, obtuse teeth dorsally.

*Hypostome* poorly sclerotised, yellowish, bearing a few setae and campaniform sensilla; stemmata present, small, in form of white spots outward mandibular fossae.

*Maxillae* (Figs 14–15, 79, 87). *Cardo* (Figs 14, 79) elongate, slightly narrowing apically, membranous, glabrous; latero-basal sclerite of cardo (Fig. 79) poorly defined and sclerotised, irregular in shape, bearing two moderately long setae and one campaniform sensillum just beneath external seta. *Stipes* (Figs 15, 87) nearly as wide as long; inner sclerite of stipes well-defined and sclerotised with short and broad internal process; apical seta of stipes nearly as long as palpus, situated at anterior margin of stipes between the bases of palpus and mala; lateral seta very short, situated beneath external side of basal palpomere; external armament composed of fringe of sparse microspinulae along anterior margin, internal armament composed of area of sparse short microspinulae extending mala; additional internal lobe absent. *Palpus maxillaris* (Figs 14–15, 87): basal palpomere 1.5 times as long as terminal palpomere; basal palpomere trapezoid, slightly elongate, 1.2 times longer than wide, with fringe of microspinulae along antero-lateral margin internally; apical seta nearly as long as terminal palpomere; terminal palpomere subcylindrical, distinctly narrowed apically, 1.3 times as long as wide, with approximately ten, short, peg-like apical sensilla. *Mala* (Figs 15, 87) weakly expanded apically, 1.2 times as long as wide; inner sclerite of mala well-defined and sclerotised, subquadrate; external armament of mala composed of one campaniform sensillum, two short, peg-like setae, and four long, robust setae apically; mala internally with four long, robust setae and dense microspinulae along inner side.

*Labium* (Figs 14, 73). *Prementum* slightly transverse, 1.3 times as wide as long, rounded; anterior margin widely arcuate, weakly emarginate at middle, with broadly rounded corners; lateral sides widely arcuate; prementum dorsally (hypopharynx) with two large microspinulate areas laterally, ventrally with densely microspinulate W-shaped area along entire anterior margin, posterior tips of this area reaching the level of bases of apical setae of corner sclerites (Fig. 73); corner sclerites of labium with poorly sclerotised anterior part, apical setae relatively short, far not extending anterior margin of prementum; five campaniform sensilla situated below base of apical setae: three apical and two basal. *Postmentum* with two short setae.

*Thorax* (Figs 10–11, 32–33, 95–96, 99). Slightly expanded, flattened, prothorax 1.1–1.2 times wider than mesothorax which is as wide as metathorax and both slightly wider than 1<sup>st</sup> abdominal segment; rudiments of legs poorly defined ventrally on all thoracic segments. Prothorax transverse, 1.6–2.1 times as wide as long; anterior membrane with densely microspinulate and glabrous areas and rather dense long setae; lateral sides evenly rounded with sparse, relatively long, whitish setae. Both dorsal and ventral plates poorly defined, unsclerotised, covered with dense colorless microteeth. Pronotal plate (Figs 10, 95) nearly entirely covered with microteeth (Fig. 99) but with glabrous areas surrounding anterior part of groove and postero-lateral corners. Pronotal groove (Fig. 95) uniramous,



Figs 10–19. Larva of *Xyrosclis crocata* Gory & Laporte, 1839. 10 – body, dorsal view; 11 – thorax, ventral view; 12 – epistome, anteclypeus and labrum, dorsal view; 13 – right mandible, ventral view; 14 – labio-maxillary complex, ventral view; 15 – right maxilla, ventral view; 16 – labrum, ventral view (epipharynx); 17 – right antenna; 18 – mesothoracic spiracle; 19 – abdominal spiracle I. Drawings S. Bílý.

poorly defined and sclerotised, yellowish-brown at anterior half, widest at apex, gradually narrowing toward base, looking double apically due to light median stripe, slightly expanded basally. Prosternal plate (Figs 11, 96) covered with dense microteeth and narrow glabrous areas along groove and large areas at postero-lateral corners. Prosternal groove (Fig. 96) uniramous, well-defined and sclerotised, particularly at base and apex, brownish, inverted T-shaped, subparallel, at base abruptly forked forming perpendicular, curved, rather long, slightly sclerotised, basal branches. Mesothorax (Figs 10–11, 32–33) transverse, 2.3–2.9 times as wide as long and 1.0–1.1 times wider than metathorax; with well-defined secondary fold dividing segment into two parts; nearly glabrous, covered with isolated, short setae; with hardly visible areas of poorly developed microspinulae laterally, ambulatory pads poorly developed both dorsally and ventrally, ovale, occasionally divided by median depression. Metathorax (Figs 10–11, 32–33) transverse, 2.1–2.3 times as wide as long and 1.4–1.5 times wider than 1<sup>st</sup> abdominal segment; lateral sides with sparse, short, whitish setae; both dorsal and ventral sides of metathorax with distinct, transverse plates covered with microteeth; dorsally and ventrally with poorly defined, transversely oval ambulatory pads occasionally divided by median depression.

*Abdomen* (Figs 10, 22) flattened; segments 1–8 transverse, slightly wider than long, sides arcuate, dorsally and ventrally bearing central and lateral microspinulate areas; lateral sides with sparse, short, whitish setae and well-defined microspinulae; 1<sup>st</sup> abdominal segment transverse, 1.5–2.0 times as wide as long and slightly narrower than 2<sup>nd</sup> segment; dorsally with cordate ambulatory pad. Abdominal segments 2–8 transverse, 1.2–1.9 times as wide as long; 9<sup>th</sup> abdominal segment transverse, arcuately narrowed posteriorly, 1.9–2.6 times as wide as long; dorsally and ventrally with narrow, zigzag-shaped microspinulate band interrupted medially on ventral side; 10<sup>th</sup> abdominal segment conical, slightly transverse, 1.4–2.0 times as wide as long, dorsally with inconspicuous microspinulate area, ventrally glabrous; apex with vertical unsclerotised anal rim.

*Spiracles* (Figs 18–19, 118–119). Mesothoracic spiracles (Figs 18, 118) of buprestoid, cribriform type, renifom, transverse, 1.6 times as wide as long, situated on sides of anterior part of mesothorax, with cancellate peritreme bearing parallel slots, without inner trabeculae; spiracles surrounded with microspinulae. Abdominal spiracles (Figs 19, 119) of the same type, renifom, narrow, weakly transverse (that on the 1<sup>st</sup> abdominal segment 1.3 times as wide as long), with a few parallel slots, situated dorsally in depressions on abdominal segments 1–8, surrounded with microspinulae.

*Proventriculus* with complicated inner armament consisting of different elements and moderately developed dorsal and ventral central stripes; large, cordiform, with two long curved gastric caeca at base which are about twice longer than proventriculus itself. Main fields formed by moderately dense, mainly isolated microteeth situated on tubercles (Fig. 109), with longitudinal stripe of longer and smaller teeth laterally; their margins with smaller and sparser, reduced teeth, anteriorly and posteriorly changing to fine microspinulae and setae. Central stripes well-developed on both sides, not extending the apices, at base with long and dense setae changing to shorter microspinulae situated in groups of 2–3 on common scale-like bases. Glabrous areas narrow, separated by central stripes.

***Xyroscelis* sp. cf. *bumana* Williams & Watkins, 1986**

(Figs 23, 34–35, 45, 49, 56, 65, 74, 80, 88, 110, 120–121)

**Material examined.** AUSTRALIA: USDA 69-22618, Intercept, 13.x.1969, Lindsey, Hart & San Pedro leg., *Macrozamia* sp. (Zamiaceae) root and soil, 3 mature specimens (2 in USNM, 1 in ZIN); two larvae were used for the total measurement, one larva for the description of mouth parts and spiracles.

**Note.** The larva of this species is quite similar to that of *X. crocata*, for this reason we do not give its detailed description; for diagnostic characters see Table 3.

**Larval characters of Polycestinae**

It should be stressed that because only single or a few species of each genus were studied, the variability and diagnostic value of many larval characters remain uncertain. For characters diagnosing the larvae of Polycestinae from other buprestid subfamilies, see Table 1 and character list below in which we selected a few most important ones:

Pronotal groove uniramous (double with parallel sides in the unique studied larva of *Sponsor* or double with slightly diverging sides in *Mastogenius texanus* Bellamy, 2002 (Fig. 40)). This plesiomorphic state also occurs in the larvae of non-Australian Galbellinae (VOLKOVITSH & BÍLÝ 2001), South American *Trigonogenium* Harold, 1869 (BÍLÝ & VOLKOVITSH 2007) (Buprestinae: Trigonogeniini), and many genera of Agrilinae but the latter lack a proventriculus and usually possess terminal abdominal appendages (sometimes erroneously referred to as urogomphi) (VOLKOVITSH & HAWKESWOOD 1990, BÍLÝ 1999). Pronotal grooves of the larvae of Buprestinae (except for *Trigonogenium*) and Chrysochroinae are inverted V- or Y-shaped.

An additional internal lobe of unclear homology occurs on the maxillary stipes (Figs 90–92, A) (= lacinia sensu BÍLÝ 1989; see also discussion in VOLKOVITSH 1979) that was previously regarded to be an important character of Polycestinae (KOLIBÁČ 2000). It is present in Polycestini, Paratrachyini and Haplostethini as well as in all other studied representatives of polycestoid (see VOLKOVITSH 2008) and acmaeoderoid lineages but absent in Prosperherini, Astraeini and Xyroscelidini (Figs 6, 15, 85–89). The absence of an additional lobe is a plesiomorphic state character present in all other buprestid larvae. Based on adult antennal sensory structures, VOLKOVITSH (2001) suggested to separate Prosperherini, Astraeini and Xyroscelidini as a particular ‘Australian’ lineage of Polycestinae which later was named the prosperheroid lineage (VOLKOVITSH 2008); according to adult characters, the Neotropical Perucolini and South African (Cape) Bulini also belong to this lineage, but their larvae are still unknown. The antennal structures of the Prosperherini, Astraeini and Xyroscelidini are somewhat intermediate between the buprestoid (plesiomorphic state) and polycestoid (derived) types, that is why we did not include them to the polycestoid lineage but keep it in the separate ‘Australian’ prosperheroid) lineage. Unfortunately, we failed to find the synapomorphies in larval characters supporting the monophyly of the prosperheroid lineage as well, but all known larvae of the lineage lack the additional internal lobe on maxillary stipes. In our opinion, the representatives of the prosperheroid lineage are the relicts of the Gondwanan buprestid fauna with unclear relations to other polycestine taxa and they possibly stand at the base of polycestine clade. Also the molecular data by EVANS et al. (2015) do not support its monophyly, though only a small part of genera was studied and the nodal support for the subclades was low.

Table 1. Comparison of the main taxonomic characters among the larvae of Astraceni, Xyrosclidini, Prospheerini, and Polycestini.

Character	Astraceni Cobos, 1980	Xyrosclidini Cobos, 1955
1. Epistome: arrangement of epistomal sensilla	Nearly linearly, sensilla in each group close each other (Fig. 3)	Trapezoidal, sensilla in each group ca. half of distance between groups (Fig. 12)
2. Epistome: sclerotisation	Well sclerotised over entire surface	Well sclerotised over entire surface
3. Labrum: palatine sclerites	Branches separated (Figs 61–62)	Branches fused (Figs 64–65)
4. Labrum: medial sensilla, composition	1 seta, 2 campaniform sensilla (Fig. 62)	1 seta, 2 campaniform sensilla (Fig. 65)
5. Labrum: anterolateral setae, ventrally	3 setae (Fig. 3)	3 setae (Fig. 16)
6. Labrum: armament dorsally	Glabrous (Figs 3, 61–62)	With narrow microsetal area along entire anterior margin (Figs 12, 64–65)
7. Antennae: articular membrane	Glabrous	Glabrous
8. Antennae: basal antennomere, anterior margin	Glabrous (Figs 7, 47)	Microspiculated (Figs 17, 49)
9. Antennae: terminal antennomere, shape and armament	Expanded apically, anterior margin microspiculated (Fig. 47)	Expanded apically, anterior margin microspiculated (Figs 48–49)
10. Antennae: terminal antennomere, apical cavity	Shallow, at anterior third of antennomere, sensory appendage protruding outside cavity (Figs 7, 47)	Shallow, at anterior third of antennomere, sensory appendage protruding outside cavity (Figs 17, 48–49)
11. Mandibles: shape, sclerotisation	Nearly isosceles triangle with poorly developed molar part; teeth short, lateral ones sitting on common bases or substituted by ridges; strongly sclerotised, black to brown (Figs 4, 53–54)	Nearly isosceles triangle with poorly developed molar part; apically with lateral teeth shifted to dorsal side, ventrally without teeth; strongly sclerotised, black to brown (Figs 13, 55–56)
12. Hypostome: mandibular fossa	Partly covered with sclerotised plate externally, inner corner with or without tooth-like projection (Fig. 44)	Covered with sclerotised plate externally
13. Maxillary cardo: latero-basal sclerite, number of campaniform sensilla	One (Figs 5, 77–78)	One (Figs 14, 79–80)
14. Maxillary stipes: additional internal lobe	Absent (Figs 6, 85–86)	Absent (Figs 15, 87–88)
15. Maxillary stipes: number of campaniform sensilla	One (Figs 6, 85–86)	One (Figs 15, 87–88)
16. Maxillary palpus: basal/terminal palpomeres, ratio	Basal nearly as long as terminal (Figs 6, 85–86)	Basal distinctly longer than terminal (Figs 15, 87–88)
17. Labium: prementum, external (ventral) armament	Glabrous (Figs 5, 70–71)	With densely microspiculated, W-shaped area along entire anterior margin (Figs 14, 73–74)
18. Labium: postmentum, armament	With two setae (Fig. 71)	With 2 short setae (Figs 14, 73)
19. Thorax, 1 <sup>st</sup> abdominal segment: presence of ring-shaped cuticular structure	absent	absent
20. Prothorax: relative width	Slightly wider than mesothorax (Figs 1–2, 28–31)	Slightly wider than mesothorax (Figs 10–11, 32–35)
21. Prothoracic plates: armament (excluding setae)	Glabrous, sometimes with inconspicuous microspiculae on anterior membrane and inconspicuous grainy or honeycomb texture along grooves (Fig. 93)	With dense colorless microteeth leaving glabrous areas along the grooves, at latero-posterior corners and base (Figs 95–99)
22. Meso- and metathoracic plates: armament (excluding setae)	Glabrous, sometimes with inconspicuous microspiculae laterally	With large areas of microteeth changing to microspiculae
23. Abdomen: armament	Mainly glabrous, with poorly defined microspiculated areas	Covered with extensive areas of microteeth and microspiculae
24. Spiracles: structure	Thoracic multi-, abdominal uni- or biloculate or both typically buprestoid with cancellate peritreme and numerous trabeculae (Figs 8–9, 114–117)	Both thoracic and abdominal spiracles with parallelly slotted peritreme without any trabeculae (Figs 18–19, 118–121)

Character	<b>Prospherini Cobos, 1980</b>	<b>Polycestini Lacordaire, 1857</b>
1. Epistome: arrangement of epistomal sensilla	Nearly linearly, sensilla in each group close to each other	Linearly, sensilla in each group close to each other
2. Epistome: sclerotisation	Feebly sclerotised anteriorly; remaining surface transparent	Well sclerotised over entire surface
3. Labrum: palatine sclerites	Branches separated (Fig. 66)	Branches separated (Fig. 63)
4. Labrum: medial sensilla, composition	1 seta, 2 campaniform sensilla (Fig. 66)	1 seta, several (up to 6) campaniform sensilla (Fig. 63)
5. Labrum: antero-lateral setae, ventrally	3 setae	2 setae (Fig. 63)
6. Labrum: armament dorsally	With narrow microsetal area along entire anterior margin (Fig. 66)	Glabrous (Fig. 63)
7. Antennae: articular membrane	With microspiculated area near the base of basal antennomere	Glabrous
8. Antennae: basal antennomere, anterior margin	Densely microspiculated ventrally (Fig. 46)	Glabrous (Fig. 50)
9. Antennae: terminal antennomere, shape and armament	Expanded apically, anterior margin microspiculated (Fig. 46)	Subcylindrical, microspiculae mainly inside apical cavity (Fig. 50)
10. Antennae: terminal antennomere, apical cavity	Shallow, at anterior third of antennomere, sensory appendage protruding outside cavity (Fig. 46)	Deep, at anterior half of antennomere, sensory appendage not protruding outside cavity (Fig. 50)
11. Mandibles: shape, sclerotisation	Right-angled triangular, with strongly expanded molar part; teeth long, isolated, sharp; only apical part well sclerotised, basal part transparent (Fig. 57)	Nearly isosceles triangle with poorly developed molar part; teeth short, lateral ones sitting on common bases or substituted by ridges; strongly sclerotized, black to brown (Fig. 58)
12. Hypostome: mandibular fossa	Covered with sclerotised plate externally	Completely covered with large, rounded apical projection
13. Maxillary cardo: latero-basal sclerite, number of campaniform sensilla	One (Fig. 81)	Two or more (up to 5) (Fig. 82)
14. Maxillary stipes: additional internal lobe	Absent (Fig. 89)	Present (Fig. 90A)
15. Maxillary stipes: number of campaniform sensilla	One (Fig. 89)	Two and more (up to 7) (Fig. 90B)
16. Maxillary palpus: basal/terminal palpomeres, ratio	Basal nearly 2 times longer than terminal (Fig. 89)	Basal nearly as long as terminal (Fig. 90)
17. Labium: prementum, external (ventral) armament	With broad microsetal area along entire anterior margin and 2 isolated microspiculated areas at the middle (Fig. 69)	Glabrous (Fig. 72)
18. Labium: postmentum, armament	With 2 long setae	Glabrous or with 2 campaniform sensilla
19. Thorax, 1 <sup>st</sup> abdominal segment: presence of ring-shaped cuticular structure	absent	Present on anterior membrane of prothorax externally of mouthparts, metasternum dorsally, and 1 <sup>st</sup> abdominal segment ventrally (Figs 38–39, 103)
20. Prothorax: relative width	Strongly wider than mesothorax (Figs 36–37)	Moderately wider than mesothorax (Figs 38–39)
21. Prothoracic plates: armament (excluding setae)	With irregular fields of microteeth and tubercles leaving large glabrous areas, and big rounded asperities along the grooves (Figs 100–101)	Glabrous, with dense longitudinal rugosity (Fig. 102)
22. Meso- and metathoracic plates: armament (excluding setae)	With fields of microteeth and tubercles	Glabrous
23. Abdomen: armament	Covered with extensive areas of microteeth and microspiculae	Glabrous
24. Spiracles: structure	Thoracic buprestoid with cancellate peritreme and numerous branched trabeculae; abdominal with parallelly slotted peritreme, trabeculae lacking (Figs 122–123)	Both thoracic and abdominal buprestoid with cancellate peritreme and numerous branched trabeculae (Figs 124–125)

### Larval characters of Australian polycestine taxa

Comparison of larval characters of Australian Polycestinae is shown in Table 1. Haplostethini and Paratrachyini are not included in the table since no Australian species were studied; for diagnostic characters of these tribes see text and key below. The principal diagnostic characters are marked with asterisk (\*).

#### Tribe Prosperherini

(Figs 24, 36–37, 46, 57, 66, 69, 81, 89, 100–101, 122–123)

**Larval descriptions.** *Prospheres aurantiopicta* Laporte & Gory, 1837 (LEVEY 1978, VOLKOVITSH & HAWKESWOOD 1999); *Blepharum sainvali* (Bílý, 2000) (BÍLÝ 2000).

**Material examined.** *Prospheres aurantiopicta* (Laporte & Gory, 1837): **AUSTRALIA: QUEENSLAND:** Imbil State Forest, 13 April, 1972, R. A. Yule leg., *Araucaria cunninghamii* Aiton ex D. Don. (Araucariaceae), ex log billets, 1 specimen, mature (ZIN); same geographic label, 6.ii.1973; larvae obtained from log billets collected in field on 13.iv.1973, 6 larvae of different instars (ZIN). *Blepharum sainvali* (Bílý, 2000): **NEW CALEDONIA: SOUTH PROVINCE:** Plain du Lacs, 27.iii.1999, S. Bílý leg., in sapwood of *Dacrydium araucaroides* Brongn. & Gris (Podocarpaceae), 7 mature specimens, 2 larvae of middle instars (8 in NMPC, 1 in ZIN).

**Diagnosis.** Body of buprestoid type with prothorax widest, much wider than mesothorax\* (Figs 24, 36–37); epicranium of buprestoid type, transparent with stronger sclerotised apodemes (endocarinae); epistome and mandibles poorly sclerotised, semi-transparent\* (Fig. 57), mandibular condyles closed, four epistomal sensilla arranged nearly linearly; medial and lateral branches of palatine sclerite separated (Fig. 66); basal antennomere densely microspinulate along anterior margin, apical cavity shallow, situated at anterior third of terminal antennomere, sensory appendage projecting beyond cavity (Fig. 46); labrum dorsally with one, prementum ventrally with two microspinulate areas\* (Figs 66, 69); maxillary stipes with only lobe – mala\* (Fig. 89); prothoracic plates with asperities\*, microteeth and glabrous areas (Figs 100–101); mesothoracic spiracles with branched trabeculae, abdominal spiracles without trabeculae (Figs 122–123); larvae wood-borers.

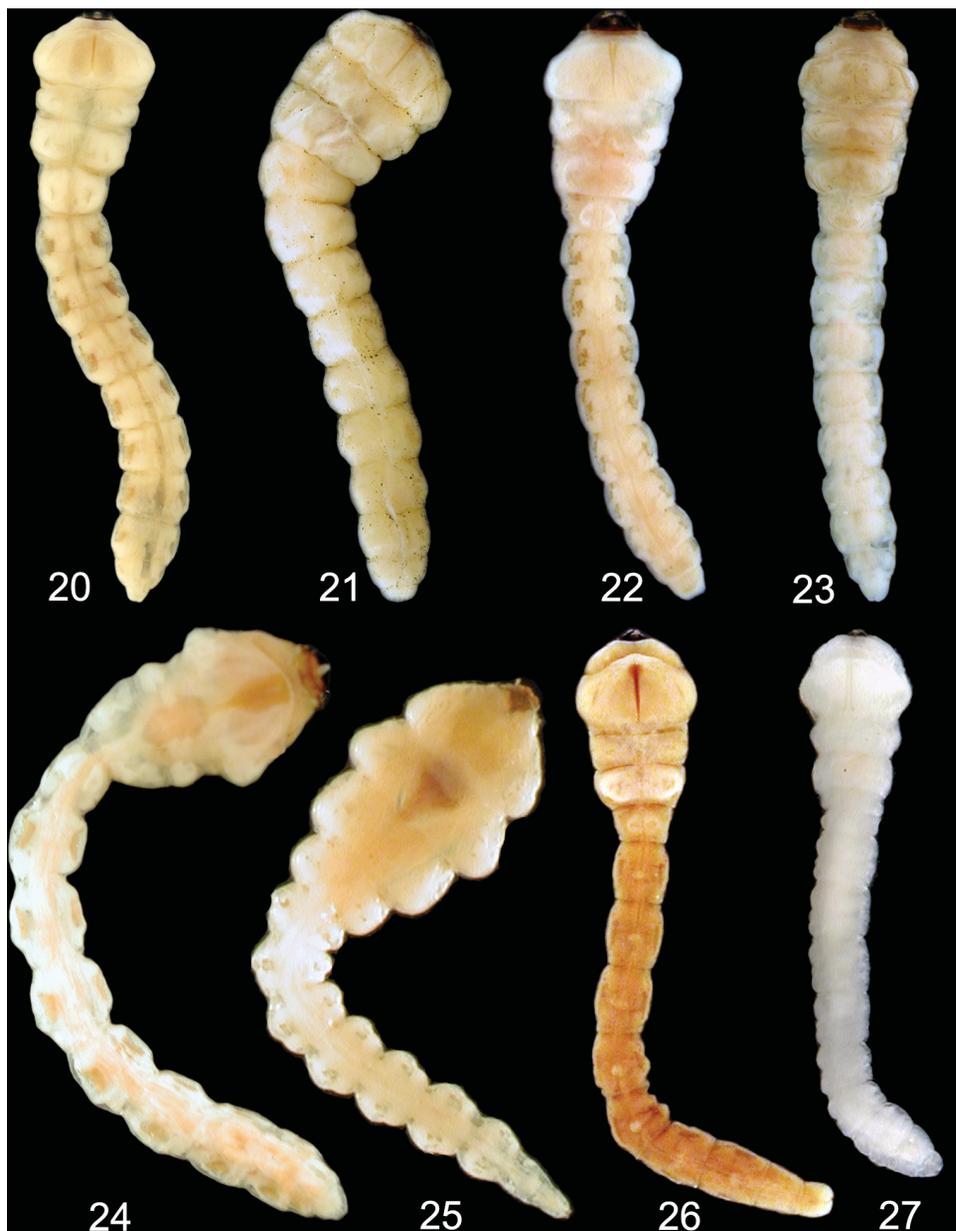
**Note.** Larvae of *Prospheres aurantiopicta* and *Blepharum sainvali* differ mainly by the shape of asperate areas along the grooves on prothoracic plates but probably that character varies in different species within these genera. We failed to find the reliable larval characters to distinguish these genera though they are easily distinguished by adult characters.

#### Tribe Astraeni

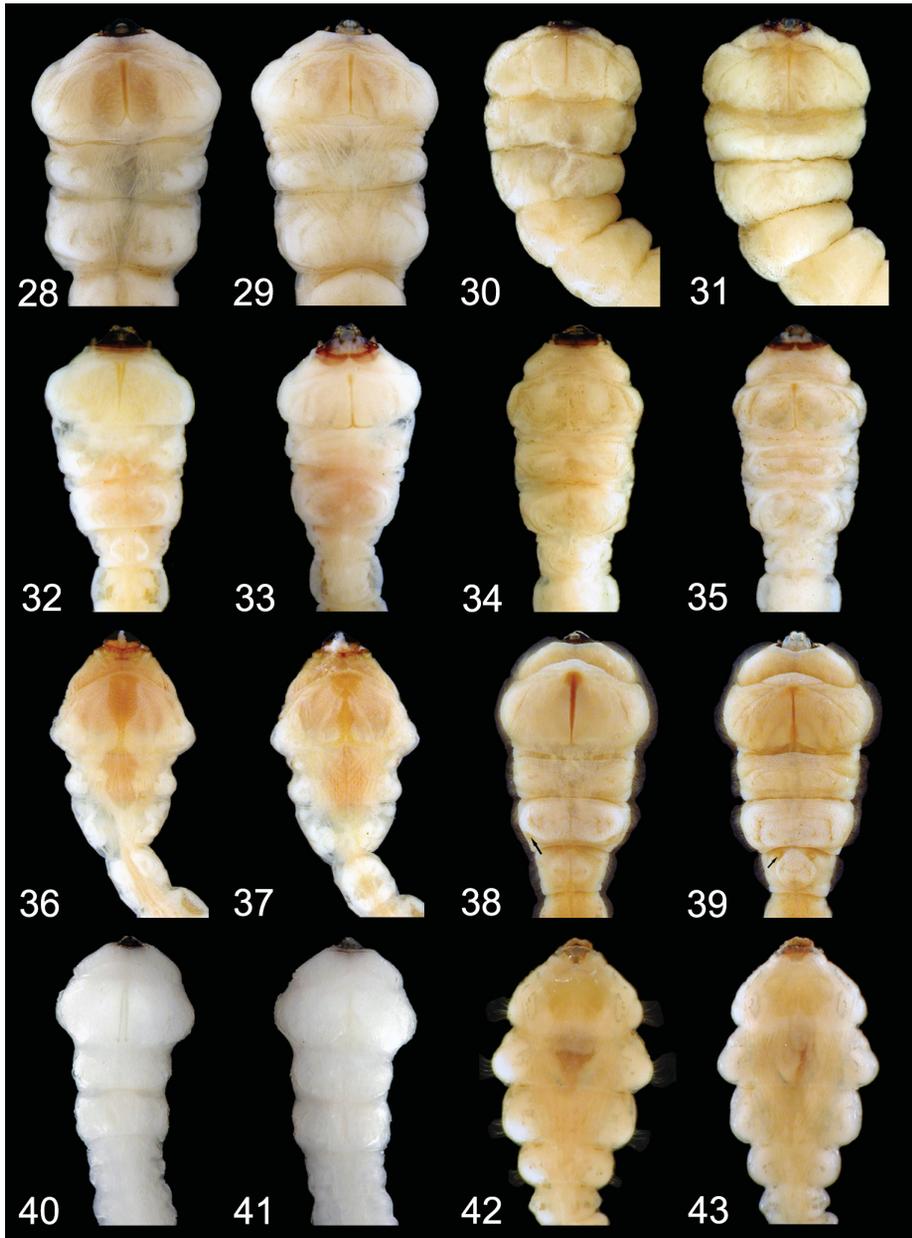
(Figs 1–9, 20–21, 28–31, 44, 47, 53–54, 61–62, 70–71, 77–78, 85–86, 93–94, 106–108, 114–117)

**Larval descriptions.** *Astraeus (Astraeus) crassus* van de Poll, 1889 (TURNER & HAWKESWOOD 1996); *Astraeus (A.) prothoracicus* van de Poll, 1889 and *Astraeus (Depollus) aberrans* van de Poll, 1886 (described in this paper).

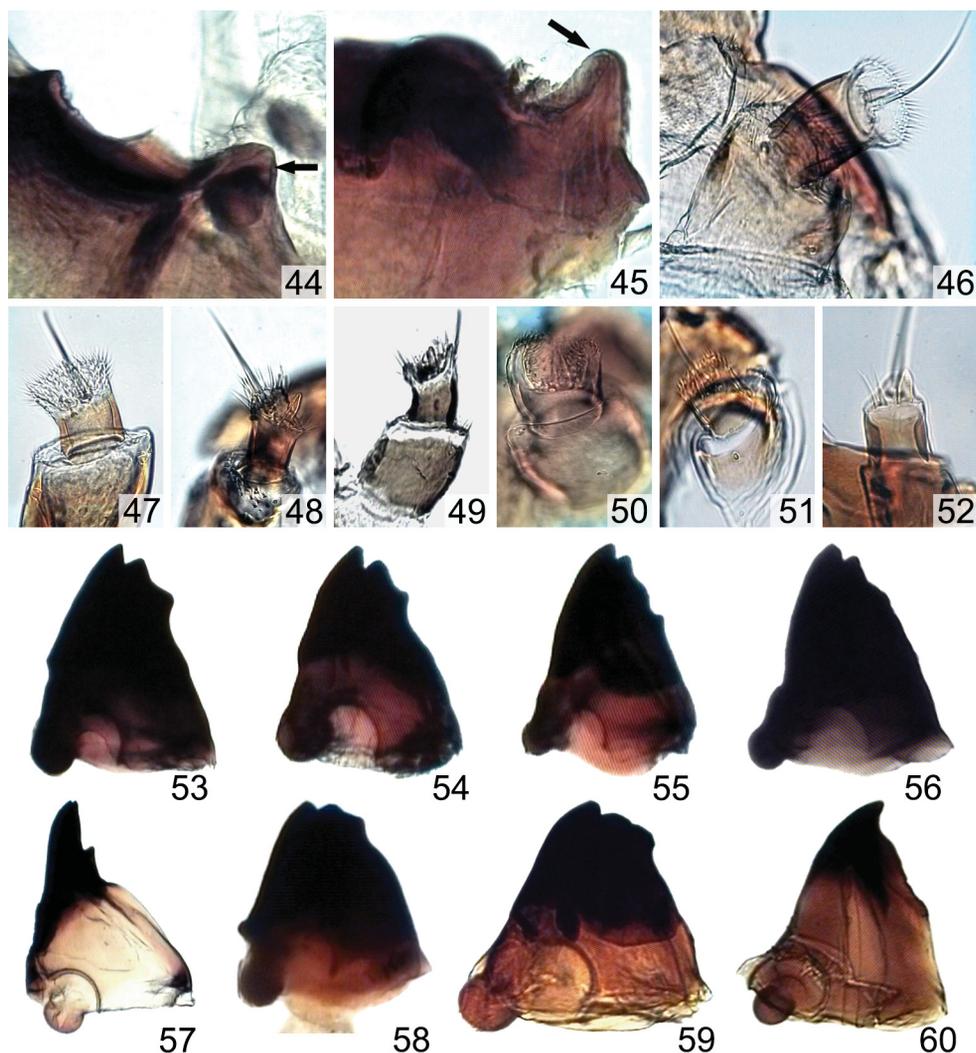
**Diagnosis.** body of buprestoid type with prothorax widest but only slightly wider than mesothorax (Figs 1–2, 20–21, 28–31); epicranium of buprestoid type; epistome and mandibles completely sclerotised (Figs 53–54); mandibular condyles open; 4 epistomal sensilla arranged nearly linearly (Fig. 3); medial and lateral branches of palatine sclerite separated (Fig. 3); apical cavity shallow, situated at anterior third of terminal antennomere, sensory appendage projecting beyond cavity (Figs 7, 47); basal antennomere, labrum dorsally and prementum ventrally glabrous (Figs 3, 5, 7, 47, 61–62, 70–71); maxillary stipes with one lobe – mala\*



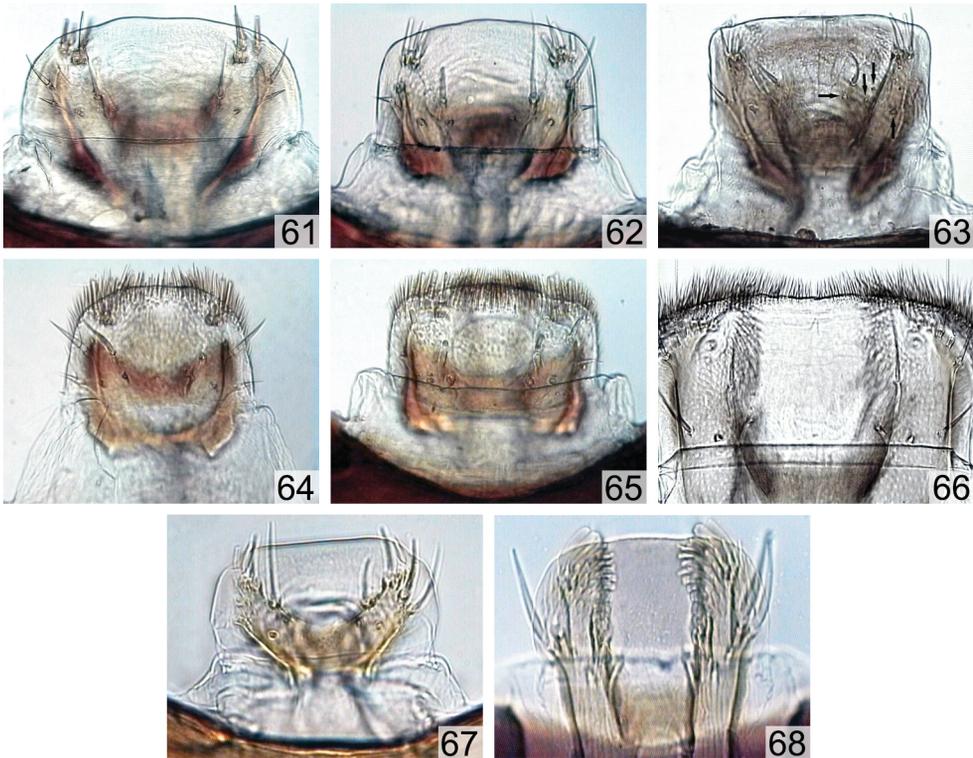
Figs 20–27. *Astraeini*, *Xyrosclidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, larval habitus (dorsal view). 20 – *Astraeus (Depollus) aberrans* van de Poll, 1886 (Australia); 21 – *A. (A.) prothoracicus* van de Poll, 1889 (Australia); 22 – *Xyrosclis crocata* Gory & Laporte, 1839 (Australia); 23 – *Xyrosclis* sp. (Australia); 24 – *Blepharum sainvali* (Bilý, 2000) (New Caledonia); 25 – *Paratrachys (P.) hederæ* Saunders, 1873 (Japan); 26 – *Polycesta (Tularensia) ?elata* LeConte, 1858 (U.S.A.); 27 – *Mastogenius texanus* Bellamy, 2002 (U.S.A.). Photo: M. G. Volkovitsh.



Figs 28–43. *Astraeini*, *Xyroscelidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, thoracic and basal abdominal segments (dorsal and ventral views). 28, 29 – *Astraeus (Depollus) aberrans* van de Poll, 1886; 30, 31 – *A. (A.) prothoracicus* van de Poll, 1889; 32, 33 – *Xyroscelis crocata* Gory & Laporte, 1839; 34, 35 – *Xyroscelis* sp.; 36, 37 – *Blepharum sainvali* (Bílý, 2000); 38, 39 – *Polycesta (Tularensia) ?elata* LeConte, 1858; 40, 41 – *Mastogenius texanus* Bellamy, 2002; 42, 43 – *Paratrachys (P.) hederæ* Saunders, 1873. Photo: M. G. Volkovitsh.



Figs 44–60. *Astraeini*, *Xyroscelidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, hypostome, epistome (details), antennae, and mandibles. 44 – *Astraeus (Depollus) aberrans* van de Poll, 1886, tooth-like projection of hypostome (arrow); 45 – *Xyroscelis* sp., lateral projection of epistome (arrow). 46–52 – antennae: 46 – *Prospheres aurantiopicta* Laporte & Gory, 1837; 47 – *A. (A.) prothoracicus* van de Poll, 1889; 48 – *Xyroscelis crocata* Gory & Laporte, 1839; 49 – *Xyroscelis* sp.; 50 – *Strigoptera bimaculata* (Linnaeus, 1758); 51 – *Mastogenius texanus* Bellamy, 2002; 52 – *Paratrachys (P.) hederiae* Saunders, 1873. 53–60 – mandibles (left): 53 – *Astraeus (D.) aberrans*; 54 – *A. (A.) prothoracicus*; 55 – *Xyroscelis crocata*; 56 – *Xyroscelis* sp.; 57 – *Prospheres aurantiopicta*; 58 – *Strigoptera bimaculata*; 59 – *Mastogenius texanus*; 60 – *Paratrachys (P.) hederiae*. Photo: M. G. Volkovitsh.



Figs 61–68. *Astraeini*, *Xyrosclidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, labrum dorsally: 61 – *Astraeus* (*Depollus*) *aberrans* van de Poll, 1886; 62 – *A. (A.) prothoracicus* van de Poll, 1889; 63 – *Strigoptera bimaculata* (Linnaeus, 1758) (arrows show campaniform sensilla); 64 – *Xyrosclis crocata* Gory & Laporte, 1839; 65 – *Xyrosclis* sp.; 66 – *Prospheres aurantiopicta* Laporte & Gory, 1837; 67 – *Mastogenius texanus* Bellamy, 2002; 68 – *Paratrachys (P.) hederiae* Saunders, 1873.

(Figs 6, 85–86); prothoracic plates glabrous\* (Fig. 93); mesothoracic and abdominal spiracles with branched trabeculae (Figs 114–117); larvae wood-borers.

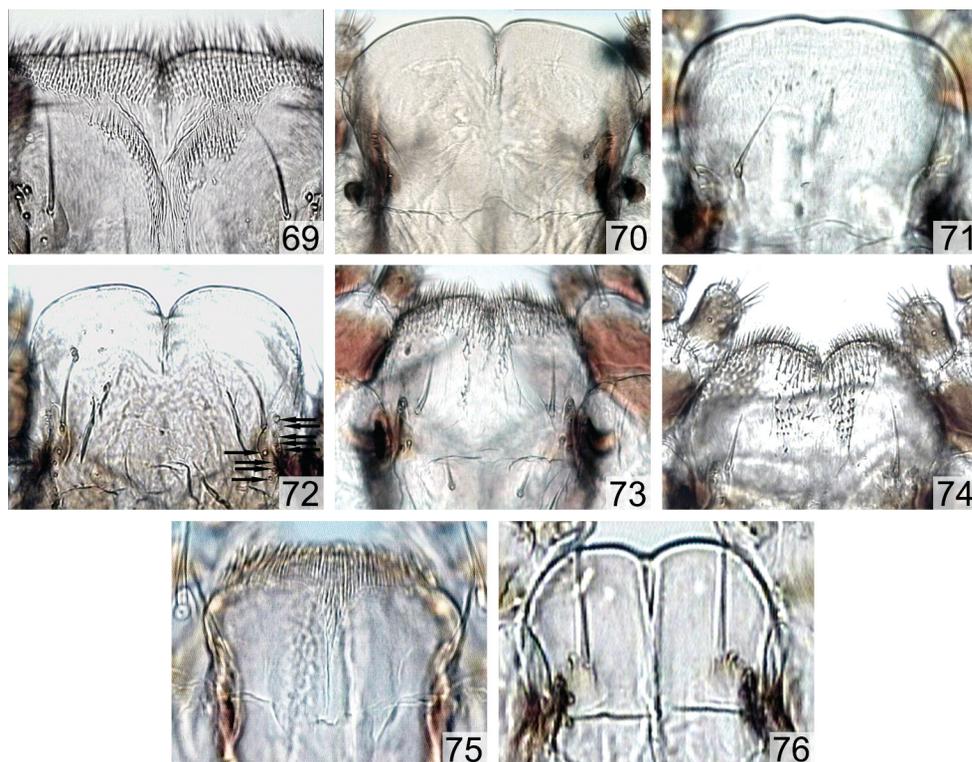
**Note.** Diagnostic characters distinguishing larvae of the studied species, each belonging to a different subgenus, are shown in Table 2. Nevertheless, we could not find reliable larval characters to distinguish these subgenera being unaware of their variability at the species level.

### Tribe Xyrosclidini

(Figs 10–19, 22–23, 32–35, 45, 48–49, 55–56, 64–65, 73–74, 79–80, 87–88, 95–99, 109–110, 118–121).

**Larval descriptions.** *Xyrosclis crocata* Gory & Laporte, 1839 and *Xyrosclis* sp. cf. *bumana* Williams & Watkins, 1986 (described in this paper).

**Diagnosis.** Body of buprestoid type with prothorax widest but only slightly wider than mesothorax (Figs 10–11, 22–23, 32–35); epicranium of buprestoid type; epistome and mandibles



Figs 69–76. Astraceni, Xyroscelidini, Prosperineri, Polycestini, Haplostethini, and Paratrachyini, labium ventrally: 69 – *Prospheres aurantiopicta* Laporte & Gory, 1837; 70 – *Astraeus (D.) aberrans* van de Poll, 1886; 71 – *A. (A.) prothoracicus* van de Poll, 1889; 72 – *Strigoptera bimaculata* (Linnaeus, 1758) (arrows show campaniform sensilla); 73 – *Xyroscelis crocata* Gory & Laporte, 1839; 74 – *Xyroscelis* sp.; 75 – *Paratrachys (P.) hederae* Saunders, 1873; 76 – *Mastogenius texanus* Bellamy, 2002. Photo: M. G. Volkovitsh.

completely sclerotised (Figs 55–56), mandibular condyles open, four epistomal sensilla arranged trapezoidly\* (Fig. 12); medial and lateral branches of palatine sclerite fused (Figs 64–65); apical cavity shallow, situated at anterior third of antennomere, sensory appendage projecting beyond cavity (Figs 17, 48–49); basal antennomere, labrum dorsally and prementum ventrally with microspinulate areas\* (Figs 12, 14, 16–17, 48–49, 64–65, 73–74); maxillary stipes with lobe – mala\* (Figs 15, 87–88); prothoracic plates with microteeth\* (Fig. 99); mesothoracic and abdominal spiracles without trabeculae, with slotted peritreme\* (Figs 18–19, 118–121); larvae feed within the fronds of *Macrozamia* sp. (Cycadales: Zamiaceae) (BELLAMY 1997, *X. bumana*; S. Bílý, *X. crocata*, personal observations).

**Note.** Diagnostic characters distinguishing the larvae of both studied species are shown in Table 3.

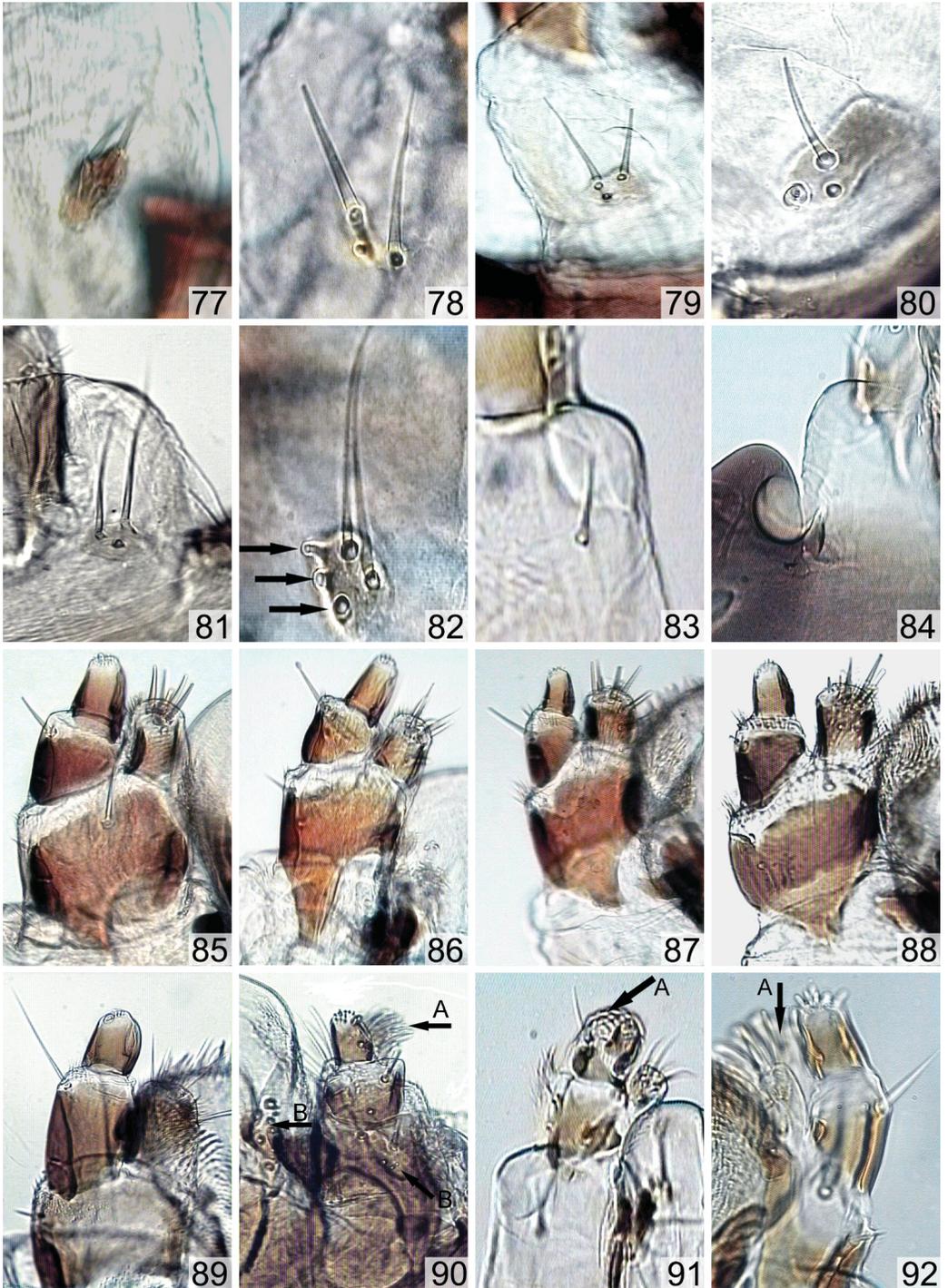
Table 2. Comparison of the main taxonomic characters between the larvae of *Astraeus (Depollus) aberrans* van de Poll, 1886 and *A. (Astraeus) prothoracicus* van de Poll, 1889.

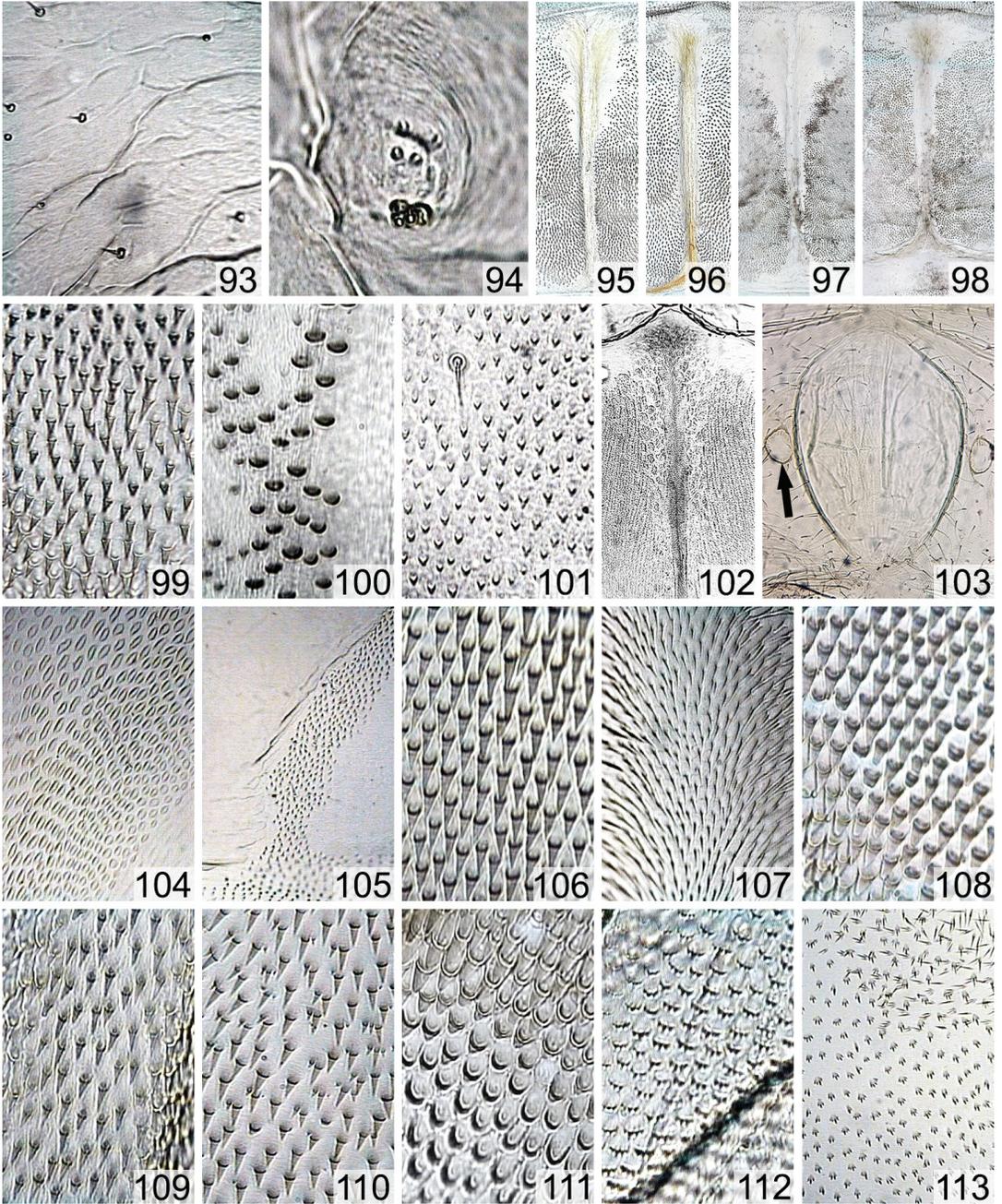
Character	<i>Astraeus (Depollus) aberrans</i> van de Poll, 1886	<i>Astraeus (Astraeus) prothoracicus</i> van de Poll, 1889
Hypostome: mandibular fossae	Internal margin forming a big tooth-like projection, nearly reaching latero-basal sclerite of cardo (Fig. 44)	Internal margin without tooth-like projection
Maxillary cardo, latero-basal sclerites	Well-defined and sclerotised (Fig. 77)	Poorly defined and sclerotised, nearly lacking (Fig. 78)
Maxillary stipes, inner sclerite: internal process	Very short (Fig. 85)	Long, well-defined (Fig. 86)
Maxillary palpus, basal palpomere: armament	Glabrous (Fig. 85)	With a few short microspinulae at antero-external corner and along anterior margin internally (Fig. 86)
Labium, lateral sides of prementum	Distinctly converging posteriorly (Fig. 70)	Subparallel (Fig. 71)
Pronotal groove	Widest apically, narrowing toward base, forked basally (Fig. 28)	Subparallel, not forked basally (Fig. 30)
Prosternal groove	Inverted T-shaped (Fig. 29)	Stripe-shaped (Fig. 31)
Meso- & metathorax: armament	With inconspicuous areas of poorly defined microspinulae laterally	Glabrous
Mesothoracic spiracles	Cribriiform, with numerous inner trabeculae (Fig. 114)	Multiloculate with a few inner trabeculae (Fig. 116)
Abdominal spiracles	Cribriiform, with numerous inner trabeculae (Fig. 115)	Uni- or biloculate with a few inner trabeculae (Fig. 117)

Table 3. Comparison of the main taxonomic characters between the larvae of *Xyrosclis crocata* Gory & Laporte, 1839 and *Xyrosclis* sp. cf. *bumana* Williams & Watkins, 1986.

Character	<i>Xyrosclis crocata</i> Gory & Laporte, 1839	<i>Xyrosclis</i> sp. cf. <i>bumana</i> Williams & Watkins, 1986
Labrum: shape	Rounded, 1.1 times as wide as long, anterior margin widely arcuated, sides slightly diverging posteriorly (Fig. 64)	Rectangular, 1.4 times as wide as long, anterior margin feebly bisinuate, sides subparallel (Fig. 65)
Labrum: palatine sclerites	Medial and lateral branches fused anteriorly and posteriorly forming kind of ring (Fig. 64)	Medial and lateral branches fused at the middle, transverse (Fig. 65)
Labium: prementum, anterior microspinulated area	With 2 very narrow stripes of microspinulae posteriorly (Fig. 73)	With 2 broad, cuneiform stripes of microspinulae posteriorly (Fig. 74)
Pronotal groove: shape of surrounding glabrous area	Slightly expanded, nearly subparallel at anterior half (Fig. 95)	Abruptly expanded at anterior half (Fig. 97)
Prosternal groove: shape of surrounding glabrous area	Narrow along entire length, slightly gradually expanded apically (Fig. 96)	Abruptly, mushroom-like expanded at apex (Fig. 98)

Figs 77–92. *Astraeini*, *Xyrosclidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, latero-basal sclerite of maxillary cardo and maxillae. 77–84. latero-basal sclerite of maxillary cardo: 77 – *Astraeus (Depollus) aberrans* van de Poll, 1886; 78 – *A. (A.) prothoracicus* van de Poll, 1889; 79 – *Xyrosclis crocata* Gory & Laporte, 1839; 80 – *Xyrosclis* sp. (lower seta broken); 81 – *Prospheres aurantiopicta* Laporte & Gory, 1837; 82 – *Strigoptera bimaculata* (Linnaeus, 1758) (arrows show campaniform sensilla); 83 – *Mastogenius texanus* Bellamy, 2002; 84 – *Paratrachys (P.) hederiae* Saunders, 1873. 85–92 – maxillae: 85 – *Astraeus (D.) aberrans*; 86 – *A. (A.) prothoracicus*; 87 – *Xyrosclis crocata*; 88 – *Xyrosclis* sp.; 89 – *Prospheres aurantiopicta*; 90 – *Strigoptera bimaculata*; 91 – *Mastogenius texanus*; 92 – *Paratrachys (P.) hederiae* (arrows show: A – additional internal lobe of stipes, B – campaniform sensilla). Photo: M. G. Volkovitsh.





### Tribe Polycestini

(Figs 26, 38–39, 50, 58, 63, 72, 82, 90, 102–103, 111, 124–125).

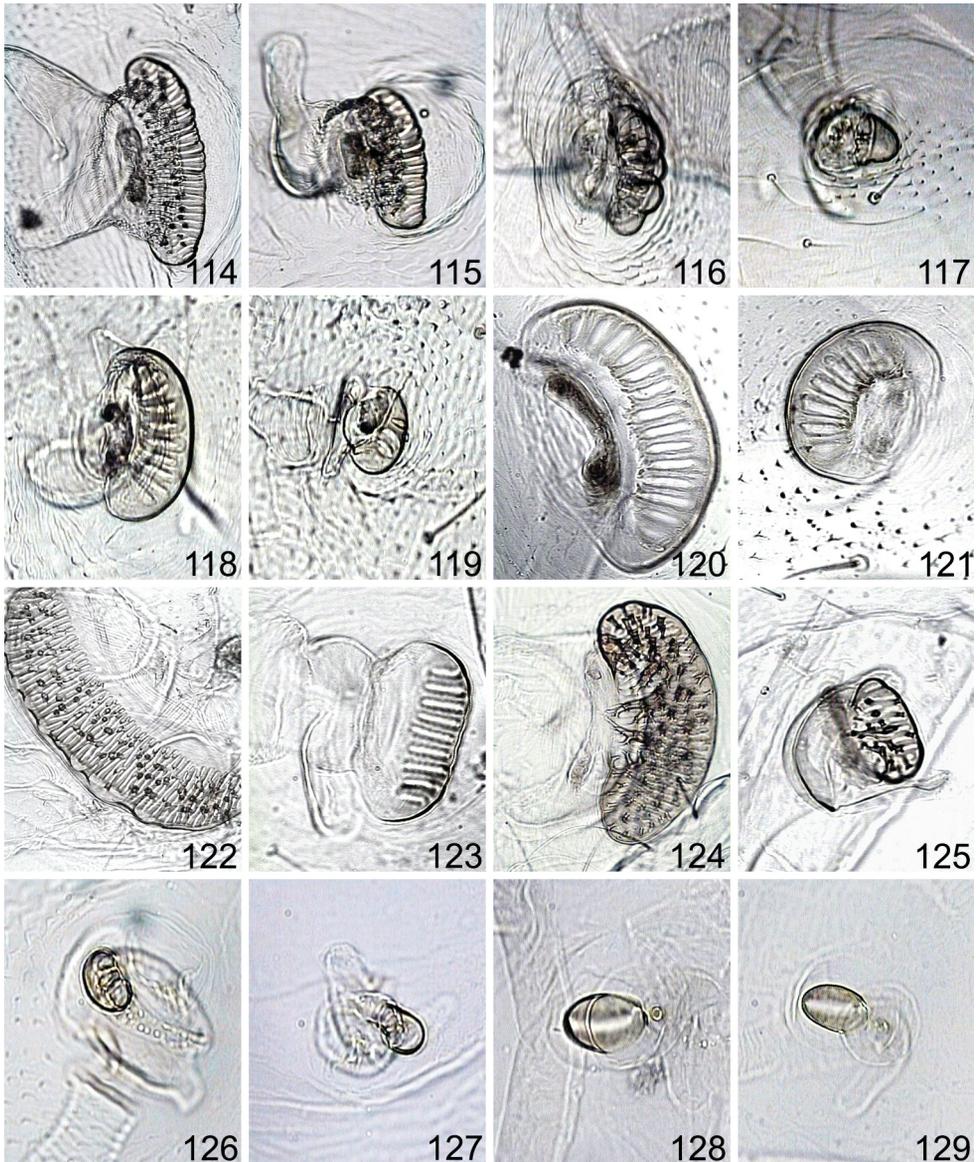
**Larval descriptions.** *Polycesta porcata* (Fabricius 1775) (Bilý 1989).

**Material examined.** *Strigoptera bimaculata* (Linnaeus, 1758): AUSTRALIA: NORTHERN TERRITORY: Howard River, 15.vii.1983, J. A. L. Watson leg., *Ceriops tagal* (Perr.) C.B.Rob. (Rhizophoraceae), 1 mature specimen (ANIC). *Strigopteroidea depressa* (Fabricius, 1775): TURKEY: ANTALAYA: Kaş, 11 km N of Kemer, 20.vii.1992, R. Pettersson leg., *Quercus* sp. (Fagaceae), 1 immature specimen (ZIN). *Polycesta (Polycesta) porcata* (Fabricius, 1775): THE VIRGIN ISLANDS: St. THOMAS: Smith Bay, 4.vii.1980, M. A. Ivie leg., 4 mature specimens (NMP). *Polycesta (Tularensia) cortezi* Thomson, 1878: MEXICO: PUEBLA: 11 km of SE Izucar de Matamoros, 4.vii.1992, M. Volkovitsh & S. Bilý leg., *Bursera simaruba* L. Sarg. (Burseraceae), ex dead trunk, 4 specimens, different instars (ZIN). *Polycesta (Tularensia) cf. elata* LeConte, 1858: USA: TEXAS: Burnett Co., Tiger Mills, iii.1885, Schaupp leg.; 2 mature larvae (USNM). *Thurntaxisia alexandri* (Schatzmayr, 1929): TURKEY: MERSIN: Silifke, vi.1995, Němec leg., *Quercus* sp. (Fagaceae), 2 immature specimens (ZIN).

**Diagnosis.** body of buprestoid type with prothorax widest (Figs 26, 38–39), mature larvae big (more than 20 mm); epicranium of buprestoid type, epistome and mandibles completely sclerotised (Fig. 58), mandibular condyles open, four epistomal sensilla arranged linearly; medial and lateral branches of palatine sclerite separated (Fig. 63); apical cavity deep, situated at anterior half of terminal antennomere, sensory appendage not projecting beyond cavity\* (Fig. 50); basal antennomere, labrum dorsally and prementum ventrally glabrous (Figs 63, 72); labrum ventrally with two antero-lateral setae\*; labrum, latero-basal sclerite of cardo and stipes with additional (up to seven) campaniform sensilla\* (Figs 82, 90B); maxillary stipes with two lobes – mala and additional internal lobe\* (Fig. 90A); prothoracic plates glabrous with longitudinal rugosity (Fig. 102); prothorax frontally (laterally to mouthparts), metathorax dorsally and 1<sup>st</sup> abdominal segment ventrally with ring-shaped cuticular structures\* (Figs 38–39, 103); mesothoracic and abdominal spiracles with branched trabeculae (Figs 124–125); larvae wood-borers.

**Note.** The presence of ring-shaped cuticular structures of unknown origin on thoracic and 1<sup>st</sup> abdominal segments and additional campaniform sensilla on the labrum and maxillae of all studied genera are probably the larval synapomorphies of Polycestini. In other respects all studied larvae differ in the shape of prothoracic grooves and some other structures including armament of proventriculus but we could not find reliable characters to distinguish the genera based on larval characters so far.

◀ Figs 93–113. *Astraeini*, *Xyrosclidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, armament of prothoracic plates, 1<sup>st</sup> abdominal segment and inner armament of proventriculus. 93, 94 – *Astraeus (A.) prothoracicus* van de Poll, 1889: 93 – texture of pronotal plate, 94 – rudiment of mesothoracic leg; 95, 96, 99 – *Xyrosclis crocata* Gory & Laporte, 1839: 95 – pronotal groove, 96 – prosternal groove, 99 – microteeth on pronotal plate; 97, 98 – *Xyrosclis* sp.: 97 – pronotal groove, 98 – prosternal groove; 100, 101 – *Prospheres aurantiopicta* (Laporte & Gory, 1837), armament of pronotal plate: 100 – along the groove, 101 – laterally; 102, 103 – *Strigoptera bimaculata* (Linnaeus, 1758): 102 – pronotal groove and adjacent rugulose texture, 103 – ring-shaped cuticular structure on ventral side of 1<sup>st</sup> abdominal segment (arrow); 104, 105 – *Paratrachys (P.) hederiae* Saunders, 1873, sculpture: 104 – mesothoracic plate, 105 – pronotal plate (top) and adjacent areas. 106–113 – armament of proventriculus (106, 108–113 – main fields; 107 – central stripe on ventral side): 106, 107 – *Astraeus (Depollus) aberrans* van de Poll, 1886; 108 – *A. (A.) prothoracicus*; 109 – *Xyrosclis crocata*; 110 – *Xyrosclis* sp.; 111 – *Strigoptera bimaculata*; 112 – *Mastogenius texanus* Bellamy, 2002; 113 – *Paratrachys (P.) hederiae*. Photo M. G. Volkovitsh.



Figs 114–129. *Astraeini*, *Xyrosclidini*, *Prospherini*, *Polycestini*, *Haplostethini*, and *Paratrachyini*, mesothoracic (114, 116, 118, 120, 122, 124, 126, 128) and abdominal (115, 117, 119, 121, 123, 125, 127, 129) spiracles: 114, 115 – *Astraeus (Depollus) aberrans* van de Poll, 1886; 116, 117 – *A. (A.) prothoracicus* van de Poll, 1889; 118, 119 – *Xyrosclis crocata* Gory & Laporte, 1839; 120, 121 – *Xyrosclis* sp.; 122, 123 – *Prospheres aurantiopicta* Laporte & Gory, 1837; 124, 125 – *Strigoptera bimaculata* (Linnaeus, 1758); 126, 127 – *Mastogenius texanus* Bellamy, 2002; 128, 129 – *Paratrachys (P.) hederae* Saunders, 1873. Photo M. G. Volkovitsh.

### Tribe Haplostethini

(Figs 27, 40–41, 51, 59, 67, 75, 83, 91, 112, 126–127).

**Material examined.** *Mastogenius texanus* Bellamy, 2002: USA: TEXAS: Jeff Davis Co., 11.3 mi W of Fort Davis on Hwy 166, 1.ix.2004, T. C. MacRae leg., *Quercus pungens* var. *vaseyana* (Fagaceae), cut ex dead twig, coll. 15.iv.2004, 2 specimens, ? mature larvae (ZIN).

**Diagnosis** (based on *Mastogenius*). Body of buprestoid type with prothorax widest (Figs 27, 40–41), mature larvae very small (less than 10 mm); epicranium of buprestoid type; epistome and mandibles completely sclerotised (Fig. 59), mandibular condyles open; six epistomal sensilla (three in each group) arranged nearly linearly\*; medial and lateral branches of palatine sclerite fused\* (Fig. 67); apical cavity shallow, situated at anterior third of terminal antennomere, sensory appendage projecting beyond cavity (Fig. 51); latero-basal sclerite of cardo reduced, single seta arises from membrane\* (Fig. 83); labrum dorsally and prementum ventrally glabrous (Figs 67, 76); maxillary stipes with two lobes – mala and additional internal lobe\* (Fig. 91: A); prothoracic plates glabrous; pronotal groove double with slightly diverging sides\* (Fig. 40); mesothoracic spiracles with a few branched trabeculae, abdominal ones – uniloculate, without trabeculae (Figs 126–127); larvae wood-borers.

**Note.** The larvae of a single Australian genus of this tribe, *Helperella*, is still unknown and for diagnosis of Haplostethini we used the only known larva of the tribe, the North American *Mastogenius texanus*. It is unclear, whether the slightly diverging pronotal groove is characteristic for all Haplostethini, for *Mastogenius* only, or even only for certain species of this genus.

### Tribe Paratrachyini

(Figs 25, 42–43, 52, 60, 68, 75, 84, 92, 104–105, 113, 128–129)

**Larval descriptions.** *Paratrachys hederæ* Saunders, 1873 (Bilý 1989).

**Material examined.** *Paratrachys (Paratrachys) hederæ* Saunders, 1873: JAPAN: NAGASAKI: Mt. Kasagashirayama, 29.iii.1983, S. Ejima leg., 3 specimens, last instar (NMPC); Mt. Kazagashira-san, 23.i.1988, Y. Ikezaki leg.; *Ficus pumila* L. (Moraceae), ex leaf mines; 4 specimens, different instars (ZIN). *Sponsor (Sponsor) gianassoi* Novak, 2002: OMAN: Dhofar, Červenka leg., ex *Acacia* sp. (Fabaceae: Mimosoideae), 2 mature specimens (ZIN).

**Diagnosis.** Body of trachyoid type with mesothorax widest\* (Figs 25, 42–43); epicranium of trachyoid type\*, strongly sclerotised; epistome and mandibles poorly sclerotised (Fig. 60); mandibular condyles open, 2 epistomal sensilla arranged linearly\*; medial and lateral branches of palatine sclerite separated (Fig. 68); apical cavity nearly completely reduced, sensory appendage and sensilla free\* (Fig. 52); latero-basal sclerite of maxillary cardo reduced (Fig. 84); labrum dorsally glabrous, prementum ventrally with microsetal areas (Figs 68, 75); maxillary stipes with two lobes – mala and additional internal lobe\* (Fig. 92: A); prothoracic plates sclerotised, glabrous, surrounded by the areas of transverse asperities and microspinulae, which also covered meso- and metathorax\* (Figs 104–105); prothoracic grooves poorly defined (Figs 42–43); mesothoracic and abdominal spiracles bi- or uniloculate, without trabeculae (Figs 128–129); leaf-miners\*.

**Note.** The larvae of Australian species of *Paratrachys* are still unknown, so for diagnosis of Paratrachyini we used the only known larva of the tribe, i.e. that of the Palaearcto-Oriental *P. hederæ*. The larva of *Sponsor gianassoi* is a wood borer of the buprestoid type that raises doubts about the affiliation of this genus to Paratrachyini.

### Key to identification of larvae of the Australian polycestine tribes

- 1 Body of buprestoid type with prothorax widest (Figs 20–24, 26–27, 28–41). Prothoracic plates not sclerotised, glabrous or covered with microteeth and asperities. Apical cavity of terminal antennomere well-defined. Wood borers. .... 2
  - Body of trachyoid type with mesothorax widest (Figs 25, 42–43). Prothoracic plates sclerotised, glabrous (Figs 42–43). Apical cavity of terminal antennomere reduced (Fig. 52). Leaf miners. .... **Paratrachyini**
- 2 Maxillary stipes with a single lobe – mala (Figs 6, 15, 85–89). .... 3
  - Maxillary stipes with mala and additional internal lobe covered with setae (Figs 90–92: A). .... 5
- 3 Prothoracic plates, labrum and labium externally glabrous (Figs 61–62, 70–71, 93). .... **Astracini**
  - Prothoracic plates covered with microteeth only or microteeth, tubercles and asperities (Figs 95–101), labrum and labium externally with microsetal areas (Figs 12, 14, 64–66, 69, 73–74). .... 4
- 4 Prothorax much wider than mesothorax (Figs 24, 36–37). Prothoracic plates covered with combined microteeth, tubercles and asperities along the grooves (Figs 100–101). Epistome and mandibles (Fig. 57) poorly sclerotised, semitransparent. .... **Prospherini**
  - Prothorax slightly wider than mesothorax (Figs 10–11, 22–23, 32–35). Prothoracic plates covered with colorless microteeth (Figs 95–99). Epistome and mandibles (Figs 55, 56) strongly sclerotised, blackish-brown. .... **Xyrosclidini**
- 5 Body large, mature larvae longer than 20 mm. Prothoracic grooves uniramous, strongly sclerotised (Figs 38–39, 102). Prothorax frontally (lateral to mouthparts), metathorax dorsally and 1st abdominal segment ventrally with ring-shaped cuticular structures (Figs 38–39, 103). Medial sensilla of labrum, latero-basal sclerite of cardo and stipes with additional campaniform sensilla (Figs 63, 82, 90: B). .... **Polycestini**
  - Body small, mature larvae less than 10 mm. Pronotal groove double with slightly diverging sides (*Mastogenius texanus*), poorly sclerotised (Fig. 40). Thoracic and abdominal segments without ring-shaped cuticular structures, mouthparts without additional campaniform sensilla. .... **Haplostethini**

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